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ABSTRACT

Eight papers making up Track II of the 1989 conference of the Professional Association for the Management of Information Technology in Higher Education (known as CAUSE, an acronym for the association's former name) are presented in this document. The focus of Track II is on funding and accountability issues, and the papers include: "A Checklist for Institutional Information Support" (Gerald W. McLaughlin and Richard D. Howard); "Colleges and Universities as a Market for Administrative Application Software" (panel discussion); "Institutional Governance: An Albatross or a Gold Mine?" (Sandra M. Statham); "Administrative Computing at Stanford: What Didn't Work and What Might" (Frederick M. Biedenweg and Catherine A. Gardner); "An Intensive Approach to Application Enhancement" (Donald E. Heller); "Aligning University Goals with Information System Strategies--Smoke and Mirrors?" (Dennis L. Kramer and Richard C. McKee); "Managing Computer Support Costs through Effective User Training: Lessons Learned at the University of New Hampshire" (Betty Le Compagnon and John F. Leydon); and "Method for Planning Administrative Information Systems Development" (Dale Bent and William Enright). (DB)

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November 28-December 1

SAN DIEGO

CAUSE89

Managing Information Technology: Facing the Issues

Proceedings of the 1989 CAUSE National Conference

TRACK II: Funding and Accountability Issues

November 28 - December 1, 1989
The Sheraton on Harbor Island
San Diego, California

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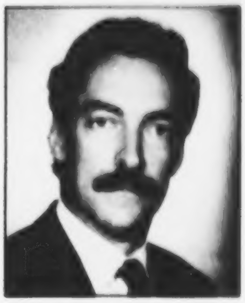
CAUSE89

Track II

Funding and Accountability Issues



Coordinator:
Mark A. Olson
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Demands for information resources are on the rise, life cycles for equipment are shortening, and total costs continue to increase. Requests for funding must compete for scarce resources. Managers of information technology have a responsibility to continually review methods and procedures for cost-effective and efficient solutions. Presentations in this track covered such topics as innovative strategies for dealing with these challenges and marketing them to top management; strategies utilizing industry partnerships; the evaluation of information technology needs on campus and the role of assessment; development of budget formulas for information technology resources; cost/benefit analyses for applications, equipment, and staffing; and ways to demonstrate accountability within institutions.

Cynthia Cross
John Gwynn

Cynthia Cross, University of Michigan; Donna Morea, AMS; Richard Legoza, SCT; Charles R. Thomas, NCHEMS; John Gwynn, IA

Betty Le Compagnon, University of New Hampshire

A CHECKLIST FOR INSTITUTIONAL INFORMATION SUPPORT

by

Gerald W. McLaughlin
Associate Director of Institutional Research
Virginia Polytechnic Institute and State University

and

Richard D. Howard
Director of Institutional Research
North Carolina State University

ABSTRACT

Planning and decision support processes are tools which, ideally, are designed to contribute information to individuals responsible for the operation of our institutions of higher education. In this paper a checklist of activities and critical attributes are presented which help to enhance the usability and effectiveness of institutional data and information in planning and decision activities. Three primary personnel responsibilities and five primary activities are identified, which define a process spanning key operational aspects of the development and maintenance of information support. The focus of the paper is on the human and management side of the enterprise, rather than the technical elements of hardware and software.

Presented at the CAUSE Annual Meeting in San Diego
November, 1989

A CHECKLIST FOR INSTITUTIONAL INFORMATION SUPPORT

INTRODUCTION

Distributed computing environments place unique requirements on information support at a college. In order to insure the value of support, it is necessary that those who provide information carefully consider both quality of the data bases and also requirements for support. In "Bridging the Gap between the Data Base and User in a Distributed Environment"[1] quality of institutional data bases was defined in the terms of reliability and validity. It was shown how these two aspects can help evaluate the problems which impact on decentralized database creation, management, access, and use. The article also noted that:

> "As information systems become more decentralized, they will tend to move from a state of order to disorder. Our challenge is to focus our efforts on areas that will simultaneously strengthen an information system's state of order while strengthening its ability to provide information to our decision makers."

Before quality information for decision making and planning support can be created, reliable and valid baseline data must be established. The article ended with the following quote from Entropy:[2]

> "Strangely enough, it seems that the more information that is made available to us, the less well informed we become. Decisions become harder to make.... As more and more information is beamed at us, less and less can be absorbed, retained, and exploited. The rest accumulates as dissipated energy or waste...."

In summary, the reader was reminded that decision makers and planners are confronted daily with a great deal of information. The first step is to insure that the information comes from data bases which are reliable and valid. Even if the data bases are reliable and valid, the data from them must be considered in terms of the process of information support to insure that they are of value to the users.

The value of information from institutional data bases is limited by the quality of the information support process. In this paper we provide a model and checklist for the development of **USEFUL** information support for the strategic planning and management activities on the campus. The creation of an information support process is a two-step process, the first of which is the collection of data.

> "Data are raw facts from which information can be constructed. The quality of data is determined by their validity, accuracy, and reliability, all of which are properties related to measurement."[3]

(See Howard, McLaughlin, and McLaughlin, 1989, for a discussion of the issues associated with the collection and maintenance of quality data.)

The second step, addressed in this paper, is the evaluation of the information support process. Many of the same reliability and validity concepts that are critical in the creation of quality data are used to insure the creation of useful information support.

> "Information consists of data that have been combined and given a form in which they convey to the recipient user some useful knowledge. Information is created when data are selected, organized, and analytically

> manipulated, and the result is given a form that informs and serves the needs of users."[3]

A MODEL

In order to monitor the quality of information support processes, both personnel responsibilities and information support functions must be considered. A model which interfaces personnel responsibilities of information support and the five functional steps in an information support process[4] is presented below. Once the personnel responsibilities and functional steps of the model have been defined, a checklist of activities and responsibilities are identified which can act as a guideline in the evaluation of useful decision support information. **Again, it should be stressed that the utility of the model and checklist proposed in this paper are totally dependent upon the desire and ability of the institution to create reliable and valid data bases.** Without motivation to improve the process, the old "garbage in, garbage out" rule for computing will apply to the information support system.

Also, it is within the context of the distributed computing environment[1] that the following personnel responsibilities and five functions are especially critical in the development of information support. These five functions provide the basis of the checklist for monitoring the information support process. The checklist, following a description of the model, is an example of a checklist which others are encouraged to modify according to the specific situation found at their institution. The use of a checklist, focused on the characteristics of a specific institution, will help insure reliable, valid, and useful information from all components in a distributed environment.

Information Personnel

In general, there are three types of people associated with the creation of information. While each has a specific role, all must be interdependent if the information development process is to be successful in creating useful information.

Technicians: These individuals are typically responsible for the collection, maintenance, and storage of the data. In general they are responsible for the hardware and software issues and have tended to not be involved in data quality issues. Recently, however, the appearance of data administration functions and information centers reflect increased pressures on the traditional "computer center" to address data quality issues with the users. This is a direct response to increased demands for decentralized processing capabilities.

Analysts: Typically, it is through these people that the integration and manipulation of the data occurs and information is created and disseminated. Before the technical capabilities that make distributed processing feasible, these people where usually found in institutional research offices. The result of their activity was to provide the link between the computer center technical people and the users of the information they created.

Users: Once information is created, these people apply it in decision making and planning activities. As they are the primary beneficiaries of the information development process, it is critical that they be involved in the identification of the initial data that feed the process. Responsibility for the quality of information falls upon the personnel involved in the information support process. Technicians have major responsibility for the reliability of the data that feeds the process. Both internal and external validity are the primary responsibility of the analysts. The users of the information must take direct responsibility for construct and content validity. While the above identifies the primary responsibilities of the individual personnel types, it must be emphasized that the overall quality of the information is dependent on the integrated efforts of all three types of personnel.

Functions of Information Support

The three types of personnel responsibilities, identified above, are responsible for the following five functions of information support development:

Selection: What processes and events are sufficiently important to measure? Selection involves positioning information development activities by identifying key areas or events and selecting data elements which measure or define the structures of those areas or events. Some measures should be taken from census data bases, others are valid when taken from the dynamic operating files.

Capture and Storage: How and when does one capture and store the data? Data elements should be captured at their source and coded consistently in categories which can answer questions. Data must be stored securely and still be accessible to those needing it. It is critical that the capture of data be coordinated through a central unit to insure that characteristics of each data element is known by all users. This function is often referred to as the data administration role.

Manipulation: What do the data mean? The interpretation of data requires the full documentation of their capture--the sample, the conditions, and timing. Standard analytical procedures are used to translate data into information. Often manipulation requires the integration of various data bases. The specific analysis is heavily dependent on the analysts' perception of users' needs.

Delivery: How is information presented? Delivery provides the user with qualitative and quantitative information. Timing involves having the information available when it is needed. The needs, analytical capability, and decision making ability of the user must be consistent with the reports. Standard reports and graphs support ease of interpreting results.

Influence: How can the information be made more useful and valuable? There are certain key points in organizational activities where the use of information can influence the direction or outcome of the activity. Presenting information at these critical points reduces uncertainty, influences or creates power, and focuses future events. Evaluation of the usefulness of the information for various purposes during this function, provides insights into the selection function.

These five functions are the process by which information support is developed from those data typically collected to support various operational functions of the institution. It is a closed loop, with the usefulness of information contributing to the criteria for selection and hence capture of appropriate data elements. It is a dynamic process which, in a decentralized or distributed environment, occurs at many points across the campus.

THE CHECKLIST

Based on the interaction of personnel responsibilites and information support functions, a series of checklist items are presented which can be used to monitor information support activities. For each functional area, these statements identify a generic set of activities and responsibilities that should be addressed within the specific organizational and management structure of each institution.

Selection:

- Technicians and analysts are involved in goal setting at all levels of the institution.
- There are multiple measures in most key areas.
- Everyone has a good idea of the management processes for the institution.
- Most user questions can be answered from census date data bases or the factbook.
- Standard definitions exist for key concepts such as "faculty" and "student."
- There is a set of written guidelines for IRM available to users.

Capture and Storage:

- A data element dictionary is readily available to analysts.
- Responsibility for data is assigned to key administrators.
- Input is audited as it is entered.
- There is an administrative systems group which coordinates data bases.
- Inconsistencies in data bases are identified and resolved.
- RFP's require compatibility with local standards.

Manipulation:

- Written procedures for coding data are available to analysts.
- Those who analyze the data use standard packages.
- User groups contain users, analysts, and technicians for all major data bases.
- Census date data bases are widely available to users.
- Administrators have analytical perspectives and computer confidence.
- Distributed data bases are easy to integrate.

Reporting:

- Standard graphic and analysis packages are used.
- A calendar of key decision dates is available to technicians.
- Periodic reports are in a standard format.
- Reports tell users the extent to which results can be generalized.
- The reports from various groups on the same topics have the same numbers.
- There are resources on campus for those who want to learn to use the information system.

Influencing:

- Members of the faculty use the information system.

- Users see the information as unbiased and reputable.
- Analysts are considered ethical.
- Key administrators often meet with those who provide the information.
- Vice Presidents and the President make frequent use of the information.
- Information providers include those who share the values of higher education and who understand the management of the college or university.

WHAT'S NEXT?

The purpose of the checklist is to insure that the information support process is reliable and valid in a distributed computing environment. To develop the checklist we have (1) identified the three personnel responsibilities associated with the development of information; (2) described the five functions which make up the information support process; and, (3) identified the relationship between interdependent personnel responsibilities and the functional components of an information support process.

If you want to monitor the quality of information support on your campus, we suggest that you build a checklist; and propose that you use the one presented in this paper as a starting point to develop your own, institutional specific, information support monitoring program. As you develop a checklist for your institution, remember that you may need to develop specific checklists for different situations within a campus-wide distributed environment.

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[2] Rifkin, Jeremy and Howard, Ted, Entropy: A New World View, New York: Bantam Books, 1980, p.43.

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CAUSE PANEL DISCUSSION

COLLEGES AND UNIVERSITIES AS A MARKET FOR ADMINISTRATIVE APPLICATION SOFTWARE

ABSTRACT

The purpose of this session was to address the following:

- From the point of view of software developers, what is the college and university market like as a customer for administrative systems?
- What is the outlook for the coming decade?
- What systems (Student, Personnel, Alumni-Donor, Admissions, etc.) are likely to be strategic?
- How will the changing technology affect the situation?
- What is the outlook for industry/university partnerships to develop new administrative applications?
- Are these relationships likely to be different in kind or scope from past arrangements?

Panelists:

John Gwynn, Vice President -
Advanced Research Technology
Information Associates

Richard Legoza, Director
Western Region Sales
Systems and Computer Technology (SCT) Corp.

Donna Morea, Vice President
Deputy Manager College and University Systems Group
American Management Systems, Inc.

Charles R. Thomas,
Senior Consultant - NCHEMS

Moderator:

Cynthia S. Cross
Systems Development Coordinator
The University of Michigan

COLLEGES AND UNIVERSITIES AS A MARKET FOR ADMINISTRATIVE APPLICATION SOFTWARE

The purpose of this session was to address the following:

- From the point of view of software developers, what is the college and university market like as a customer for administrative systems?
- What is the outlook for the coming decade?

The moderator requested each panelist to address a specific question and then invited comments from the other panelists. Questions from the floor followed. The following is a distillation of the discussion as taped.

I. Compared with "commercial" customers, do colleges and universities behave differently?

Are they less likely to see administrative systems as strategic?
Are they more (less?) cost conscious?
More (less?) resistant to changes in hardware and technology?
Are they slower to make decisions?

Donna Morea, Vice President
Deputy Manager College and University Systems Group
American Management Systems, Inc.

Yes, they are slower to make decisions, but that's the only bad part. I've worked in a number of industry areas within our organization, and find that colleges and universities score very well in other respects.

My company and Carnegie Mellon University jointly sponsor an award which honors people from a variety of industries for strategic visions in information technology. One of the winners this year was Lou Herman of Waubonsee Community College. He has really brought the electonic campus to Waubonsee and even extended its reach to high schools in the community. I think it is also worth noting that the first DB2 implementation of one of our financial products was not done by American Express, Citicorp, or someone from one of the other industries, but by one of our college and university clients.

COMMENTS

Legoza: I agree that colleges and universities are more open to new technologies, strategic systems, etc. - especially compared with government, which is my company's other vertical market.

Thomas: I agree with Donna, although I think that on the point about moving slower, some of the schools - particularly in the private sector - can make decisions faster than she suggests.

Gwynn: I disagree in part. It seems to me that colleges and universities are interested in being on the leading edge, but not necessarily on the "bleeding" edge - especially for administrative systems. The planning horizon for most schools is two or three years out. That's why they are so interested in having vendors use the latest technology. They figure by the time they have the funding and planning in place what is now bleeding edge will be established technology. That was my observation regarding technologies such as databases, MIS, etc.

II. Colleges and Universities vary widely in size, complexity, management styles and relative resources.

How do colleges and universities vary in their receptivity to purchasing vendor software - rather than in-house development - when compared by those characteristics?

How do they compare in successful use of purchased systems to support critical operations?

Richard Legoza, Director
Western Region Sales
Systems and Computer Technology (SCT)

When I was a consultant for many years, I saw a profile of successful systems implementation:

- the customers took ownership (it was"OUR" system),
- there was end-user leadership for the project, including technical leadership,
- there was full-time project management,and
- there was executive level support.

Above all, when the institutions take projects seriously, and when the customers and the vendor are not naive about the implementation, we see successes.

As for the criteria of size, complexity, resources, and management style, I'm seeing fewer differences in the purchase versus buy decision because of size of the institution. Small schools tend to have more problems getting resources for implementation, but I've been seeing equally severe resource constraints at some big schools because of budget cuts.

All schools think they are different and complex. We are seeing a new generation of highly flexible systems, with rules based processing, which can be made to respond more quickly to changes in academic policy.

As for management style, I don't believe it's always easier to mandate a system. I've seen presidents and vice-presidents mandate a system, but the people who have to use the system in the end impact the success of a system. Purchased systems appeal to risk takers in management, those who want to see changes happen very quickly.

As for resources, when institutions take these questions seriously, they find that they can justify the dollars to buy the system. Where they fall short is in allowing for the people resources, particularly for implementation. Somehow they seem to think "I'll just work 80 hours a week, rather than my present 60 hours and that will get the system installed." That is not appropriate.
I think institutions have personalities, like people, and it is more useful to look at those factors - risktaking, leadership and commitment etc, rather than size, complexity and resources as predictors of success in systems implementation.

COMMENTS
Morea: I agree with Rick. I am seeing many pressures among large, complex institutions to force people who previously developed in-house to look at packaged systems. While the fact that vendors are now developing systems which can be more easily tailored to individual needs and the pressure on managers to meet timetables are both important, I find that two other factors are now critical. First, the cost of maintaining these systems is enormous. Schools are spending 85 - 90 percent or more of their budgets to maintain old systems. 2) Technology is changing at a faster rate than ever and schools want insulation against changes in technology. They see vendors as an ally in providing that insulation.

Thomas: One pattern I've seen is that smaller institutions buy entire integrated systems, whereas the larger schools buy application by application and adapt them to the local environment. Partly that's because you can't change everything at once in a large place. These schools will replace application by application on a cycle, doing the integration by themselves. Then by the time they've replaced all their systems, it's time to start all over again.

Gwynn: In my observation bigger schools buy hardware and then they buy software; smaller ones buy software and then hardware. I worked on the institution's side for a number of years and now I've been with a vendor for several years. In my experience schools which form partnerships with their vendors and work in an environment of mutual trust are more successful than those who take the attitude that the vendor is trying to rip them off. The vendors work with many schools and it is to their advantage to have the school succeed.

III. **As we look to the future, what administrative computing systems are likely to be critical to the success of colleges and universities in preserving their financial and intellectual viability? Why?**

Charles R. Thomas,
Senior Consultant - NCHEMS

There are two critical areas. The first is the transactions systems which "have" to be done, i.e. the student systems, the financial systems, et cetera. The issue is how to do it with the minimum grief and cost. If you look at the CAUSE member profile, they list about 155 different systems in 11 categories. The vendors don't begin to cover all the categories. I expect to see an increase in the number of those but there will still need to be some areas developed in-house. What I see in the way of development in that area are strategic alliances of two kinds - one is the traditional one of a school and vendor working together to build a system to be marketed elsewhere. Then I see groups of schools, consortia or groups of large schools, commissioning systems for their own use which may or may not be sold elsewhere.

Of this class of transactions system I see two types as critical: the first is Admissions (You've got to get them in the front door), and second is the Alumni system, especially in private schools - and even some publics. Those two systems drive the production function of the institution. Then next is Human Resources.

Then there is the whole area of Strategic Systems - these are systems which make information from transactions systems available to department heads and others so they can use it. What I see happening is that schools are not putting people online to their transactions systems but are extracting data on a cycle to another database system of some kind. This prevents them from modifying the records, and provides time-date stamped files for analysis using standard PC (workstation) tools.

The next level emerging in Strategic Systems are Executive Information Systems which combine snapshots of the institutional data with external information for analysis at the workstation by department heads and others.

In the future I foresee the introduction of Expert Systems, taking the skills of the best people such as benefits counselors, admissions, and financial aid counselors, and then developings way to get the right information to the right people. Another strategic issue is getting libraries and computing centers to work together.

IV. How will the changes in technology which we can foresee affect the characteristics of administrative systems colleges and universities want/need? How will these factors affect the ability of software developers to provide systems which will fill the needs of many different customers?

John Gwynn, Vice President
Information Associates

We are right on the threshold of a major revolution in the way information can be accessed and processed. Higher education is not unique in being affected by many of them, but it is the combination of these factors which makes the situation so difficult. These are the factors which will shape the information environment of the 90's.

INFORMATION ENVIRONMENT OF THE 90'S

1. Relational Database
2. Ad hoc query and report generation.
3. Workstation based.
4. Cooperative/Distributed Processing
5. Homogeneous user interface
6. SAA ... NAS
7. Transparent operating system
8. Transportable software
9. Increased faculty and departmental involvement in administrative processes.
10. Non-homogeneous environment
11. Rapidly changing technology
12. More in hardware and operating system
13. More generic porducts
14. More productivity products

As I see it vendors will need to build the very difficult, complex products - like LOTUS. The fragmentation and variety of higher education institutions means that vendors don't get multiples in their applications software. To get beyond this, the vendors need to move into a technology which will provide as much flexibility as possible in adapting to individual institutional needs.

Also -

- We will see more and more use of productivity tools such as CASE.
- There will be more off-loading from mainframes into the workstation, which leads us into the UNIX environment.
- We are seeing more and more faculty involvement in student counseling and guidance which leads to more need to access student information and more need for academic support systems.
- Standards are an important issue because otherwise we are into a standard of product survival.
- We pressured by a need to deal with non-homogeneous hardware and a concurrent demand for a homogeneous user interface.

I see a rapidly changing technology which will be jerking everyone around, and that the vendors are going to be major players.

COMMENTS

Morea: In the next decade I see that vendors need to develop delivery methods for systems, i.e. training. We have gotten smarter about developing systems, and adapting to new technology. We are talking about giving access to all these systems to faculty and staff all across the campus. We now have to figure out how to teach users to use sytems - and how to use use technology such as video and expert systems to do so.

Also digital imaging and optical disk technology is now at the point of stabilization and ready for use. I see a lot of applications possible, for example collecting all the paperwork for financial aid applications so that it can be routed electronically.

Legoza: It is exciting to see the technology arrive so that institutions can take 70 - 80 percent solutions and modify them to meet their needs. I think that is affecting the types of institutions we vendors are talking to these days. We are seeing more institutions which used to develop their own systems looking at vendor packages.

QUESTIONS FROM THE AUDIENCE

How will CASE tools fit in on campus?

Gwynn: Many institutions will want to modify systems bought from vendors. They will want to use the same productivity tools as vendors. Vendors will have to use CASE tools becuase campuses will use them. The only way vendors can compete with in-house development is if we sell multiples and spread the cost across several institutions.

Also CASE will be important for modifying and maintaining systems. Consider how desireable it would be to maintain systems at the design level rather than at the code. The next generation of vendor applications systems will be designed in case.

Legoza: One spinoff of the desire to use CASE is that, whereas Chuck Thomas mentioned the tendency of the larger schools to install new systems one at a time, we are now seeing some larger schools buying whole set of systems because they want to use these standards and this technology.

Morea: I'd like to add that CASE tools solve a lot of problems in customizing at client sites. When you look at what is wrong with systems, it's usually a design problem. Being able to do the work once and propagate from the design to the screens and the code and also integrate development with documentation is a key advantage of CASE.

Which CASE tools are being used at your firms?

Morea: AMS is using Excelerator at the design stage, with local enhancements "around the edges" to generate screen maps, code, and documentation and development. Systems are being developed on LANs of networked PS/2's.

Legoza: SCT is using Oracle's CASE tools and design dictionary.

Gwynn: For analysis IA is using PRISM from Index Techology; for design we use Excelerator (one of IBM's strategic alliances), and APS from Sage for code generation.

Institutional Governance: An Albatross or A Gold Mine

Sandra M. Statham
University of Arkansas
Fayetteville
Arkansas

In 1983, the Department of Computing Services at the University of Arkansas moved to new facilities located at the southwest corner of our 319-acre campus. This physical isolation from the heart of the campus dramatically represented the psychological separation between Computing Services and University administration. In 1987, Computing Services set out to determine how other organizations had approached this "us versus them" problem and discovered academic research results indicating that the "role and contribution" of information support organizations ranks as one of the top five key issues in information systems management. Along with this tidbit, we found a couple of management mechanisms that seemed very apropos for higher education. Although 1989 finds us in the same facilities, the psychological separation has lessened dramatically. We feel this is a direct result of implementing several of the techniques we uncovered, and that the same techniques may benefit other colleges and universities.

Institutional Governance: An Albatross or A Gold Mine

Sandra M. Statham
University of Arkansas

When Computing Services moved into its new facilities in 1983, we were excited. After all, we were moving off of the first, fifth, and eighth floors of a men's dormitory building into a facility that had been built just for us, and we would all finally be physically located together. Although there was some grumbling about the fact that we would be located over a mile from the administration building, most felt that the improved facilities would more than compensate for the distance problem. That may have been true at another time, but what no one foresaw was the effect on the campus of the microcomputer revolution. Computing Services was no longer a monopoly, and users no longer felt the need to hike to either their cars or to our building simply to be able to access our services. It was not long before the physical isolation became a symbol of our psychological separation from the rest of the campus community.

All efforts to remain part of the day-to-day functioning of the University during this time frame were initiated by individual managers. A coordinated effort was not pursued until early 1987 when Computing Services' new director arrived. After sizing up the situation, he made the mainstreaming of our services a departmental priority. Part of the strategy was to determine how other computing organizations were actively coping with similar problems, and a "lit review," an idea taken from our academic brothers and sisters, was initiated.

In 1986, the Society for Information Management and the MIS Research Center at the University of Minnesota jointly conducted a Delphi survey to determine what information systems executives and corporate general managers considered as top issues in information systems management (Brancheau and Wetherbe, 1987). The survey results identified the following top five issues:

- Strategic Planning—Information support organizations need to engage in strategic planning in order to adapt to changing technologies and environments in a timely fashion. In addition, long-range planning, if it is to be successful, must be aligned with the company's strategic business planning.
- Competitive Advantage—Information systems can and do provide weapons to fight the competition. In order to take advantage of potential opportunities, information support organizations must become more responsive to the needs of their companies.
- Organizational Learning—Future prosperity is tied to the use of appropriate technology. In order for users to determine the appropriate technology, they must first learn about alternatives. Information systems professionals are expected to take a leadership role in providing the necessary training.
- Role and Contribution—Information support organizations are generally considered as "back office" functions rather than as vital, contributing components of a business. Information support organizations must work with corporate managers to assist them in appreciating a more integrated role.
- Alignment in Organization—The effectiveness of an information support organization can be either helped or hindered by the formal reporting relationship it faces.

The bad news was that we had weaknesses in all of these areas. The good news was that we now had a foundation for a turn-around strategy since all five issues contained two common elements: top management involvement and education. The next step was finding the appropriate mechanisms for implementing our strategy. The question now became, could proven business techniques be useful in a university environment?

CHARACTERISTICS OF UNIVERSITY ENVIRONMENTS

Although sources could be found that detailed the differences between higher education and business (e.g., Birnbaum, 1988; Wyatt, 1989), none were found that addressed the similarities. One possible reason for this could be that the similarities are not considered important. Robert Birnbaum implies this in his book, *How Colleges Work*, when he says, "The differences between academic institutions and business firms are significant enough that systems of coordination and control effective in one of these types of organization might not have the same consequences in the other" (p. 21). Although Birnbaum does go on to adapt current organizational behavior theory to the higher education environment, he continues to minimize similarities when he quotes *Policy Making and Effective Leadership: A National Study of Academic Management* written by J. V. Baldridge, D. V. Curtis, G. Ecker, and G. L. Riley: "the organizational characteristics of academic institutions are so different from other institutions that traditional management theories do not apply to them" (cited in Birnbaum, p. 28). Since so much attention is devoted to the importance of the differences, a review of a few of the characteristics that distinguish colleges and universities from the business world is warranted.

Institutional Governance

Institutional governance is one of those phrases that I have heard bandied around ever since I got my first job in higher education over 20 years ago. Although it was years before I finally saw a definition in print, the phrase itself was pretty descriptive, particularly when used by a faculty member to justify his or her rights in a decision-making situation. Birnbaum refers to the "Joint Statement on Government of Colleges and Universities" published by the American Association of University Professors in *Policy Documents and Reports, 1984 Edition* when he says, "The document articulated the concept of governance as a shared responsibility and joint effort involving all important constituencies of the academic community" (cited in Birnbaum, p. 8). What this really means is that, with institutional governance, authority/power is diffused. Management is generally by consensus. Just because you have administration on your "side" does not mean that you will be successful in pursuing a particular course of action. Also, depending on the particular issue, administration's backing alone could prove a detriment.

The concept of multiple constituencies is a key to understanding institutional governance. The obvious constituencies are faculty, administration, and students. In reality, these groups only touch the tip of the iceberg. Several years ago, I was involved as a graduate business student in a research project that attempted to measure organizational effectiveness in higher education by looking at the expectations of multiple constituencies. Our first assignment was to identify these constituencies. Of course, we added several other obvious groups to the above list such as alumni, the community, donors, employees, and the government. Our next step was to design and administer a survey instrument. In addition to collecting information related to the demographics of each respondent, our questionnaire solicited the individual's feelings concerning 130 statements related to desirable characteristics for an educational institution.

The results of our initial research highlighted the fact that even within the major constituency groups, different expectations existed. For example, the results for tenured faculty differed from those for non-tenured faculty. Rank also had a significant impact. Graduate students viewed the institution differently than undergraduates, etc. In every case, however, each constituency felt that its role was important to the successful functioning of the institution. Actually, this was not a surprise. Human nature is such that each individual wants to feel that he or she is important. Although the concept of institutional governance may cause university personnel to feel that they have more of a "right" to be involved, human nature is the same no matter where you are employed.

Academic Freedom

Academic freedom fuels the concept of institutional governance. Whereas institutional governance indicates that each constituency should have a voice in how the institution is managed, academic freedom removes some of the limitations associated with that voice in other environments. There is little fear of retribution. From my own rather limited view, I have seen university administration criticized much more frequently and harshly by other university personnel than their counterparts in business or government. A recent article in *The Chronicle of Higher Education* was describing "bad times" in one university's recent past and referenced "unproved charges of sexual harassment" against its former president and faculty accusations that the former president had shut "them out of the policymaking process" (Harrison, 1989, p. A3). When it rains, it pours. Of course, it is always easier to talk about people after they have left. One thing is fairly obvious, if the college or university community is not given the opportunity to have a say-so in the governing of the institution, they will still use their voices, just somewhere else.

Academic freedom not only relates to what one says inside or outside of the classroom and to which research interest one pursues, it also relates to where time is devoted. Time is a valuable commodity. For every issue, there will be those who do not place enough importance on it to devote time to it. However, this does not necessarily mean that they do not want to take part in any decision making that takes place related to the issue. Birnbaum states, "Faculty may fight for the right to participate in committees and then not attend meetings" (p. 170). Often, the opportunity for expression or involvement is more important than the actual partaking. On the other hand, there are also issues that are important enough to the individual that significant time would be invested if the opportunity for involvement was there. The major difficulty is in predicting which issue falls into which category.

Business or "Hobby"

Another major difference between higher education and business that could actually explain a number of the other differences relates to the definition of the organization's purpose. Most businesses place significant importance on increasing shareholder wealth. There is little ambiguity here. On the other hand, there is much ambiguity when colleges and universities try to define their purposes. In the grand scheme of things, the purpose of an educational institution is to prepare individuals to contribute to society. Although this romantic view is comforting, in reality, our institutional missions are much more complex. Depending upon one's affiliation with a specific constituency, different, sometimes conflicting, goals of the institution may be emphasized. A joke I have heard in various forms throughout my computing career goes something like, "This would be a great place to work if it weren't for the students," or "... the faculty," or "... the administration"—depending on the perspective of the speaker. There are at least as many perspectives as there are constituencies.

PARTICIPATIVE MANAGEMENT

There are, of course, many more differences between specific institutions of higher education and the business world, but there are also many differences among individual colleges and universities themselves. Since the majority of my formal education took place in a College of

Business Administration, I was decidedly prejudiced and determined to steal and adapt any mechanism that I perceived as having even the slightest chance of working, despite the differences. Furthermore, my favorite technique, stolen from the human resource management discipline, appeared to have the necessary characteristics to work in the higher education environment of institutional governance. I started pursuing participative management.

What is it?

Rosabeth Moss Kanter defines participative management as "the building and nurturing of a collaborative team that is more fully consulted, more fully informed than the ordinary—one that shares responsibility for planning and reaching outcomes" (1985, p. 197). In her book *The Change Masters* (1983, pp. 34-35), Kanter states:

> Participative teams are not equivalent to 'groupthink,' or inaction without consensus, or management by committee—three negatives to many American managers. They are action bodies that develop better systems, methods, products, or policies than would result from unilateral action by one responsible segment, or even from each of the team members working in isolation from the others.

When should you use it?

Kanter (1985, p. 198) describes twelve situations when the use of participative teams could have a positive impact on the organization:

- To gain new sources of expertise and experience.
- To get collaboration that multiplies a person's effort by providing assistance, backup, or stimulation of better performance.
- To allow all of those who feel they know something about the subject to get involved.
- To build consensus on a controversial issue.
- To allow representatives of those affected by an issue to influence decisions and build commitment to them.
- To tackle a problem that no one 'owns' by virtue of organizational assignment.
- To allow more wide-ranging or creative discussions/solutions than are available by normal means.
- To balance or confront vested interests in the face of the need to change.
- To address conflicting approaches or views.
- To avoid precipitous action and explore a variety of effects.
- To create an opportunity and enough time to study a problem in depth.
- To develop and educate people through their participation: creating new skills, new information, and new contacts.

When should you ignore it?

Kanter (1985, p. 198-199) also describes eight occasions when the use of participative teams could have a detrimental effect on the organization:

- When one person clearly has greater expertise on the subject than all the others.
- When those affected by the decision acknowledge and accept that expertise.

- When there is a 'hip pocket solution': The manager or company already knows the 'right answer.'
- When the subject is part of someone's regular job assignment, and it wasn't his or her idea to form the team.
- When no one really cares all that much about the issue.
- When no important development will result or others' knowledge would neither contribute to nor be served by their involvement.
- When there is no time for discussion.
- When people work more happily and productively alone.

How does it relate to today's issues?

I am reassured by the fact that the concept Kanter, and others in the human resource management discipline, refer to as participative management is growing in popularity. Recent publications from only a handful of sources extol the virtues of developing partnerships to improve the probability of success in computer-related projects (Alter, 1989, p. 56; Bruce, 1989, p. 56; Currid, 1989a, p. 81; Currid, 1989b, p. 91; Freund and Schlier, 1989, p. 45; Inmon, 1989, p. 24; May, 1989, p. 4; Ryland, 1989, p. 14; Scheier, 1989a, p. 91; Scheier, 1989b, p. 91; Stone, 1989, p. 74). Surely participative management, shared responsibility, teamwork, partnerships, or however else you might label the concept of involving users, would work in an environment where institutional governance reigns.

UNIVERSITY OF ARKANSAS STRATEGIES

As noted above, our strategy contained two major facets: top management involvement and education. We chose to implement it using a participative management approach. The implementation itself consisted of several activities that were somewhat dependent upon one another. At a minimum, they worked in concert with one another to achieve our objective.

Executive Symposium on University Computing

Top management commitment and support has been cited as a prerequisite for any organization to successfully implement a program that crosses territorial boundaries (Freund and Schlier, 1989, pp. 45-46; Glover, 1988, p. 19; Marks, 1989, p. 14; Nolan, 1982, p. 75; Scheier, 1989a, p. 91; Stone, 1989, p. 76). The need for computing organizations to adopt a marketing philosophy has also experienced recent popularity in the literature (Bouldin, 1989, p. 26; Bruce, 1989, p. 44; May, 1989, p. 4; Moad, 1989, p. 100; Ryland, 1989, p. 14). At the 1988 CAUSE National Conference in Nashville, our director described how these ideas came together one day while he was reviewing his "junk mail" (Zimmerman, 1988, p. 105). The result was a half-day "free seminar" for the University's Chancellor and vice chancellors that we called the Executive Symposium on University Computing. If you were able to attend Dr. Zimmerman's session last year, you may remember the acronym he used to describe it—ESUC. In addition to providing our administration with some needed information, the symposium also increased Computing Services' credibility. It was so well received that the Vice Chancellor for Academic Affairs requested that we repeat it for the Deans' Council. It was later repeated for the university-wide Computing Activities Council and for our departmental staff.

Individual Partnerships

One thing is certain in a university environment. There is an ample supply of expertise. Although I cannot speak for all colleges and universities, the ones that I have experienced have uniformly encouraged faculty to share their expertise with the outside world via consulting.

Our strategy included trying to find expert faculty with goals similar to ours that would lend support to some rather hefty projects in the "inside" world. For example, a faculty member in the College of Engineering was very interested in the concept of networking the campus since he had recently been involved in networking his college. He had also served as a consultant in this area. We developed a partnership with him where he contributed the ideas, and we did the leg work. When it came time to brief the Chancellor, he delivered the presentation. Simply by virtue of the fact that a well-respected faculty member made the presentation, the Chancellor knew that at least one academic college was behind the project. The next thing we knew, we had a budget (albeit not all we asked for) and an ad hoc committee appointed by the Chancellor to implement phase one of a campus-wide backbone network.

Another partnership we developed with a faculty member had similarly dramatic results. We already knew that we needed to engage in strategic planning for computing resources for the entire campus. We also knew that our academic colleges would not be too receptive to the idea of Computing Services "telling" them what to do. Since one of our major topical areas in the ESUC was the need for coordinated planning, we had also received feedback that the Chancellor and vice chancellors recognized this need too. The problem was determining how to proceed without alienating our academic brothers. This time, a faculty member in the College of Business Administration came to our rescue. He had just accepted the chairmanship of the University's Computing Activities Council. Once again, we developed a partnership where he contributed the ideas, and we did the leg work. Although it took 18 months, we now have a campus-wide plan for computing resources.

Computing Activities Council

The Computing Activities Council could be considered the University's answer to the concept of a steering committee. It is appointed by the Chancellor and "reviews, monitors, and recommends policies related to the needs, uses, budget allotments, and information control measures for the computing facilities and functions as a hearing body for proposed modifications to those policies" (*Faculty Handbook*, 1986, p. 32). Its membership consists of faculty representatives from each of the University's colleges and a couple of administrators. Prior to 1987, even though the Council met monthly during the academic year, it did little more than rubber-stamp policies such as how long reader files could be stored on the system before they were purged. The academic-types accused the Council of being an administrative committee and the administrative-types said the Council was dominated by academicians.

When the new faculty chair took over in 1987, things started to change. First, Computing Services assumed the clerical functions associated with calling meetings, etc. This relieved the chair of having to spend significant time with details, and he could devote more of his time to really important matters. Next, the chair developed a number of subcommittees to deal with different issues: administrative information systems, library automation, microcomputer management, networking, planning, and supercomputing. The same kind of partnership that Computing Services had formed with the chair soon became associated with each of the subcommittees as well as the Council as a whole. Council presentations to the Chancellor were much more effective than requests from Computing Services to the Vice Chancellor for Finance and Administration that were then forwarded to the Chancellor. At the end of one such presentation, the Chancellor queried two faculty members representing two different colleges as to their positions on the issue. When both responded positively, the Chancellor responded that if those two colleges agreed on something, it must be inevitable.

Ad Hoc Committees

"Ad hoc committee" is just another way of describing a participative management team. It can be a very powerful device when used wisely. One of the ingredients we found essential to the successful functioning of an ad hoc committee is knowledgeable leadership. Over the past two years, the Chancellor has appointed three ad hoc committees related to computing. The Computer Network Planning Committee was assigned the task of implementing phase one of our campus-wide network backbone. Once this task was complete, the ad hoc committee was excused and a new subcommittee of the Computing Activities Council was formed to work with the University's networking specialists. The Student Information System Committee was formed to develop specifications for a new, integrated student information system. After the specifications were complete, this committee too was excused and a new committee is being formed to oversee the acquisition and implementation of a new system. The third ad hoc committee formed was the Library Automation Committee. Its purpose is to develop specifications. Although committees can sometimes be heavy to carry around, we have found that the benefits of involving all players is worth the weight. This is particularly true when you consider that Computing Services may have been the representative left out as has happened in the past.

Computing and Information Technology Management Principles

Several months ago, our attention turned from dealing with specifics such as implementing the network backbone, upgrading the mainframes, or acquiring a student system to thinking in more general terms. Although we have made much progress in the past couple of years by using a participative approach, it seems reasonable that someday we may want to function a little more efficiently, particularly on routine matters. The literature tends to toot the horn of a full-functioning steering committee/user board (Bouldin, 1989, p. 26; Drury, 1984, p. 256; Glover, 1988, p. 19; Marks, 1989, p. 14; Nolan, 1982, p. 72; Reck and Reck, 1989, p. 89). Although the Computing Activities Council could serve such a role, we were not fully comfortable with it as a long term solution as it stands today. For this reason, we were quite excited this spring when we ran across an article in *Harvard Business Review* by T. H. Davenport, M. Hammer, and T. J. Metsisto entitled "How Executives Can Shape Their Company's Information Systems" (1989, p. 130). This article discussed the development of principles to guide computing and information technology management. We started the first step this past summer. Computing Services' managers held several meetings to develop a "strawman" set of principles. These principles are now being reviewed by the Vice Chancellor for Finance and Administration with the idea that they will eventually be presented to the Chancellor and other vice chancellors for acceptance. Along the way, the Computing Activities Council will also be provided the opportunity to have input. Once the principles are accepted, they could be used by Computing Services to make routine decisions and would define those occasions when decisions needed to be taken directly to the Council.

RESULTS

Today, Computing Services is generally considered to have a vital role in the day-to-day functions of the University. This is a quantum leap from the time when the typical computer user would rather do almost anything than to have to deal with us. The change did not occur overnight, and we still have a long way to go. The essential thing is that today we are perceived as being headed in the same general direction as the rest of the campus. We believe that the activities described above account, at least in part, for this change in perception. The key, however, has been our genuine openness. We have both listened to and acted upon the concerns of our campus community.

Setbacks

Although we feel that our partnerships have produced positive outcomes, the process is not as easy as it may sound. One of the major difficulties is time. Sometimes, things seem to take forever. It is often tempting to think that you could have already implemented something in the time it took just to educate the players. Expectations of progress must constantly be downgraded to match actual progress. In order to minimize disappointment, each individual meeting must be viewed as only a small part of the whole. When discussions start going in circles, or get way out on a tangent, even though it seems like it would save time to cut the conversation off, it is better to let it run its course or to subtly redirect it. Occasionally, such a conversation might be just what is needed to convince the last dissenter. Finally, sometimes you have to step back and take a long-range perspective just to see how far you have come. All in all, I imagine that the process is like plastic surgery. It is no fun while you are going through it, and the process seems to take forever, but the results are generally worth the trouble.

Successes

There is no doubt in my mind that if Computing Services had set out alone to implement the network backbone, we could not have achieved the quality of results we have today, even though it would have been available much earlier. It took a faculty member at a committee meeting asking if the goal was to implement the cheapest alternative or to implement what was best for the University to get everyone behind the concept of a network that the University could look upon with pride. Somehow, it would not have been the same if a systems analyst had asked this question. I believe that a significant indicator of our success is that people refer to UARKnet as the "University's network," not "Computing Services' network." This is a far cry from the old days when they had to use "Computing Services' [mainframe] computer."

The Future

We plan to continue to use the participative partnership approach for major University projects, particularly those that have far reaching implications such as the network backbone and the student information system. Now that we have some experience, we have learned first-hand those things which can either make or break the experience. Not surprisingly, we were not the first to uncover these. Kanter (1985, p. 224) actually concludes her discussion of participative management by offering the following ten suggestions for organizations that would like to implement a participative approach:

- Start small and with local issues.
- Neither promise nor expect too much.
- Allow people to define for themselves the issues they want to discuss and to opt out of those they wish to avoid.
- Involve parties whose power might be at stake and give them important, rewarded roles in the new system.
- Provide education on both the skills of participation/decision making and the issues to be discussed.
- Maintain leadership.
- Make sure minority views are heard; be wary of group pressure.
- Keep time bounded and manageable.
- Provide rewards and feedback—that is, tangible signs that the participation mattered.
- Expect participative teams to wax and wane; they supplement, rather than replace, the hierarchy or routine structure.

Of the above, our experience indicates that "maintain leadership" is probably the most critical. We might even suggest that you change it to "maintain knowledgeable leadership." A vision of the future is needed. This is a piece of cake if the leader represents the information support organization; however, this has not usually been the case with us. It then becomes a challenge for your organization to turn the appointed leader into a real leader.

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Administrative Computing at Stanford: What Didn't Work and What Might

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Abstract

In 1987, Administrative Computing at Stanford underwent a major reorganization that included moving the organization under a new Vice President, creating new management structures, and decentralizing applications support programmers into the line organizations. This paper explains some of the causes leading up to those changes and attempts to assess what has worked and what hasn't in financing and managing administrative computing at Stanford. The first section of the paper discusses organizational and management issues, the second the financial strategies, and the paper concludes with some thoughts on charged-out services written 25 years ago by the 1972 Nobel Prize winner in economics, Kenneth Arrow.

Administrative Computing at Stanford:
What Didn't Work and What Might

I. Introduction

In 1987, administrative computing at Stanford underwent a major, and for some, stressful, reorganization. The purpose of this paper is to describe some of the key factors that led up tho this reorganization and explain some of the management and financial strategies adopted in rebuilding a stable, responsive administrative computing environment.

The choices institutions make about to structure their budgets and their budget processes often determine how difficult or easy certain ventures are to start and how well others will succeed.

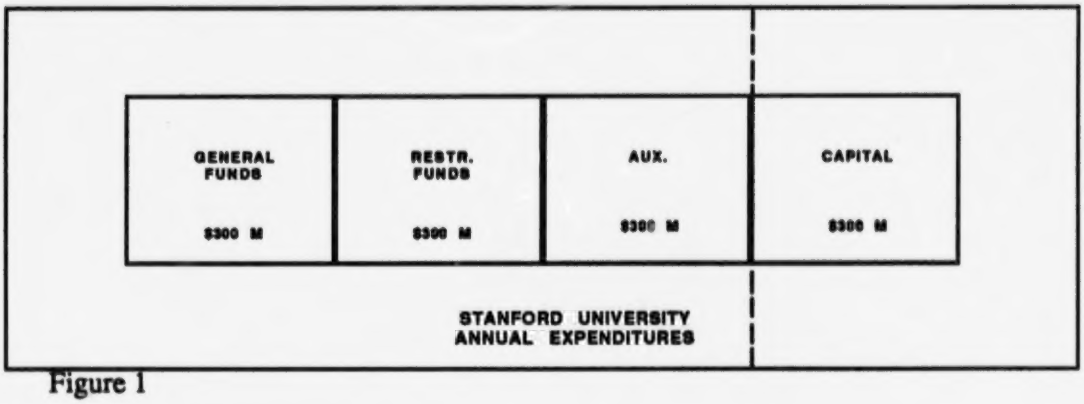

Figure 1

Total Expenditures at Stanford

As Figure 1 shows, to the nearest 100 million dollars, Stanford spends $300 million annually in general funds, $300 million in Restricted Funds (restricted to the use of specific schools, departments or activities), $300 million in Auxiliaries (such as the Linear Accelerator, the Faculty Practice Program, the University Press, Intercollegiate Athletics, etc.), and another $300 million in Capital expenditures such as new buildings.

The fact that such a large portion of the expenditures are made in the Restricted Funds Category means that the institution is very independent and entrepreneurial. And, this independence and the local control of such large resources means that the preferred mode for new adventures is charge out (i.e., service centers). For those unfamiliar with Service Centers, these are essentially what industry would refer to as profit centers, except that they are not allowed to run profits.

II. Management Structure in 1986

Figure 2 is one depiction of a Stanford Organization Chart for 1986. As most university employees know, organization charts for universities are completely dependent on who is writing the chart as, for the most part, organization charts are either never written down or not shared.

In 1986 there were six Vice Presidents. Excluding the Medical Center, which was and continues to be mostly independent, the largest Vice Presidential Areas were the Provost's (who is also the Chief University Budget Officer) and the Vice President for Business and Finance.

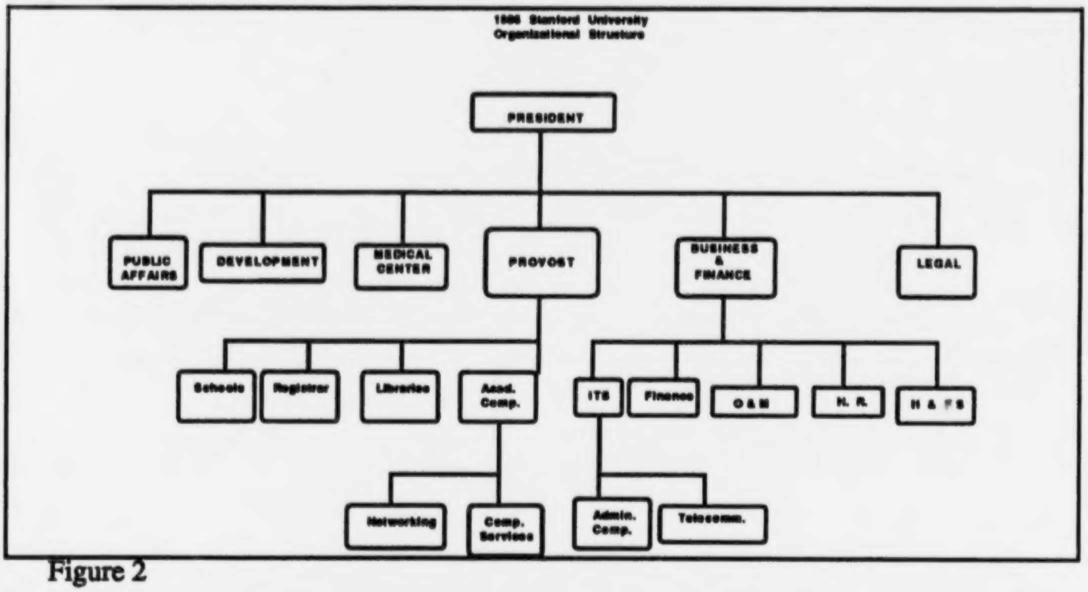
1986 Stanford University
Organizational Structure
PRESIDENT
PUBLIC AFFAIRS
DEVELOPMENT
MEDICAL CENTER
PROVOST
BUSINESS & FINANCE
LEGAL
Schools
Registrar
Libraries
Acad. Comp.
ITS
Finance
O & M
H. R.
H & FS
Networking
Comp. Services
Admin. Comp.
Telecomm.

Figure 2

Major local systems applications had been built in the Development Office (reporting to the Vice President for Development), the Registrar's Office and Libraries (reporting to the Provost), Telecommunications (reporting to the Director of ITS), and the Controller's Office and Human Resources (reporting to the Vice President for Business and Finance). These local applications were written in SPIRES due to a University policy, adopted in 1982, that central data bases have similar structures.

Information Technology Services (ITS) and the Vice President for Business and Finance were responsible for the entire range of administrative computing services. Central computing capacities were provided on a fee for usage basis from ITS. Application support programmers for both maintenance and development of systems were available to local units for hire from ITS.

Funding for these resources resided in different locations. Funds to pay for computing capacities resided in the local units budgets along with funding for applications maintenance. Funding for development of new systems resided in the staff function of the Vice President for Business and Finance.

III. Management Problems with this Structure

The authors have heard said, both by Stanford folks and by non-Stanford folks, that the main problem ITS had was that its mission and goals were not in alignment with those of the University. In our opinion, this simply is not true. We believe that ITS and its previous leaders listened very closely to what the community wanted and did everything possible to provide that level of service. This included extensive computer related consulting services and everything else from providing copy centers to post office box services. Virtually everything that someone wanted was provided.

The problem was not the services, it was the cost of those services. And, the cost center model which had allowed tremendous growth based on local demand ultimately provided for the downfall of ITS.

What Went Wrong?

1. Lack of Capacity Forecasting

Both local units and central ITS did capacity forecasting to some degree but neither integrated their forecasts with each other. The local areas typically had someone who worked for central ITS responsible for making projections but this person was in an awkward situation. The local unit frequently did not want to be told that they would need 15-30% more capacities and furthermore did not have funding to pay for capacity increases of this magnitude. Thus, local units typically did not have official forecast estimates and if they did, they were simple statements that next years capacity needs would fit within the units budget (i.e., something like 5% growth).

Central ITS, on the other hand, knew that 5% growth was unrealistic and that based on historical data, 30% growth per year was a much better estimate to use in determining when machine upgrades were needed.

2. Flat or Declining Rates

The result of this capacity planning, or lack thereof, was that ITS assumed computing capacities would grow by 30% per annum and thus determined that they could decrease rates by 10% per year and still increase total expenditures by 20% per year.

3. Expenditure Control

Expenditure control was the principle area where the problem manifested itself. The key users of these services (the local applications) were not happy paying for the free consulting services that were being offered to support the rest of the administrative community.

4. Budgeting for New Systems

Budgeting for new systems didn't work because new systems were forced to pay average costs rather than incremental costs. And, more importantly, the central budget officer was either unable or unwilling to pull back funds from areas that received windfalls.

5. 1986 deficit

The result of all this was that, in 1986, ITS ended with a $2 million deficit and a whole lot of finger pointing.

The local application areas blamed ITS because, "how could we project how much our systems were going to cost when ITS keeps changing its rates."

ITS blamed the local application areas because. "If ITS controlled application development, then the applications wouldn't use so much computing capacities."

Staff for the budget process blamed the Vice President and his staff for not controlling expenditure growth and the Vice President blamed the budget staff for not anticipating that the local areas would not have enough funds to pay for their computing needs.

After many months of this and a review committee established by the Provost to reduce ITS expenditures, the Provost finally declared a stop to the finger pointing and created the following new computing structure at Stanford.

IV. 1988 Organization Chart

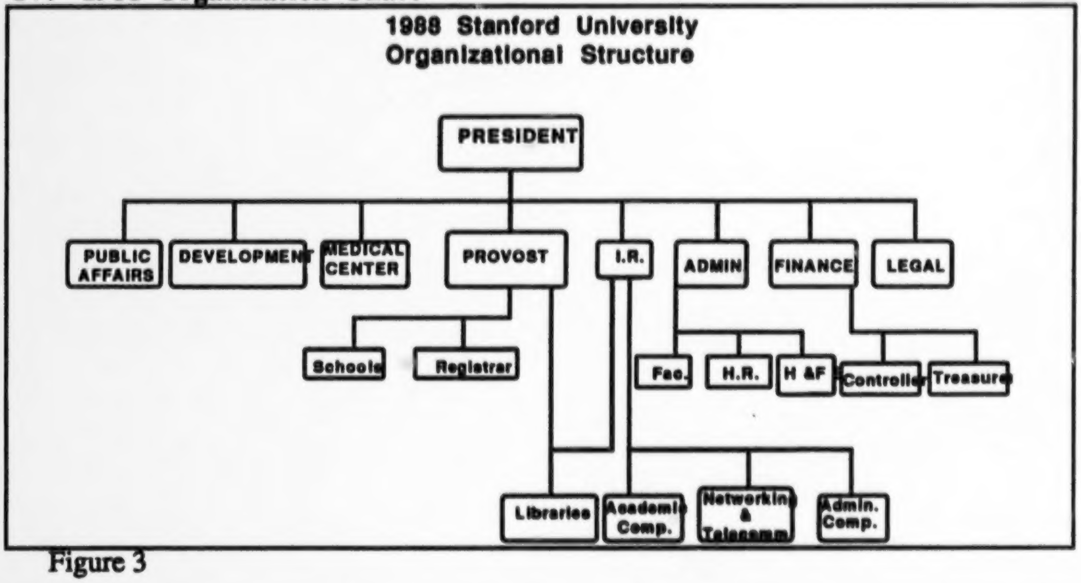
1988 Stanford University
Organizational Structure
PRESIDENT
PUBLIC AFFAIRS
DEVELOPMEN
MEDICAL CENTER
PROVOST
I.R.
ADMIN
FINANCE
LEGAL
Schools
Registrar
Fac.
H.R.
H &F
Controll
Treasur
Libraries
Academi Comp.
Networkin & Telecomm
Admin. Comp.

Figure 3

Figure 3 depicts the changes that took place from 1986 to 1988. Not one but two new Vice Presidential areas have been formed. Information Resources (IR) is now responsible for Academic Computing, Administrative Computing, Networking and Telecommunications Services and Library Technologies. In addition, the Vice President for Business and Finance's desire to move into new ventures resulted in the creation of an eighth Vice President for Administrative Resources. This VP took over Human Resources, Facilities Planning, Operations and Maintenance and Student Housing and Food Services.

The structure of Administrative Computing Services also changed. Whereas in the past ITS provided the computing capacities on a charge out basis and hired the applications programmers, under the new structure the applications programmers were decentralized to the local areas and computing capacities are now purchased on a pricing agreement basis.

The management structure of administrative computing also changed with the creation of the Core Resources Allocation and Management Group or CRAM for short. (There were some unhappy people at this name but after discussing some worse names, CRAM stuck.) CRAM's charge, as its name indicates, is to allocate core capacities to the central, core applications and to manage the use of those resources.

Here too was something that didn't work. The first pass at creating CRAM was to have the Assistant Vice President for Information Resources (Chair), the Controller, the University Budget Officer, the person in charge of the applications development fund, and the Director of Administrative Computing as the members. Needless to say, this structure did not go over very well with the University Officers in the Libraries, Registrars Office, or the Development Office. After all, these offices were still the core clients.

So, after a little more thought, it was decided that CRAM should in fact include its primary clients (i.e., the senior officer responsible for each of those applications areas) in addition to those mentioned before.

V. The Need for a Creative Financial Strategy

The organizational solution that proposed decentralization of the applications programmers, recentralization of funds for mainframe services, and an oversight management group called CRAM created a unique set of challenges for a financial strategy to support this new entity. Essentially, the financial strategy had to achieve the following goals:

1. Create a funding/charging mechanism that would assure the authority of the new CRAM management structure.

Without some control over resources, the new management group would have little clout and insufficient accountability to make the new reporting relationships work.

2. Support control of Applications Programming in the line organizations

A major complaint about the old organization was one of the lack of understanding of the essential University processes that systems had been designed to support. They were not adequately designed with client needs in mind.

3. Protect the University Operating Budget from uncontrolled growth in computing costs.

As mentioned earlier, unconstrained growth in computing costs hitting the Operating Budget had to be brought into control. It was the key factor in triggering the reorganization of administrative computing.

4. Maintain an equitable charge-out strategy for cost recovery to meet Federal A-21 regulations governing service centers.

> Because Stanford is a major research University with administrative computing costs ultimately allocated to federally sponsored research projects, our Service Center charge out policies must meet the criteria of federal regulations. Principal of these regulations is the requirement that users be charged equitably to assure fair costing to Government sponsored projects.

5. Provide long-term stability for the Data Center that would assure timely hardware and software upgrades as necessary.

> While controlling costs to the University remains a primary concern it is equally important to maintain the Data Center's technology at a level that optimizes Stanford's needs against the opportunities created by technological advances. Upgrades on our IBM mainframe units are needed on 2-3 year intervals to meet our client needs and to keep up with the technology so we don't find ourselves in a technological cul de sac.

VI. The CORE Concept for Funding Primary Administrative Systems

In order to meet all of the objectives outlined above, the concept of CORE was developed. Essentially, the idea was to have the Provost enter into a partnership with the Stanford Data Center to purchase a piece of the IBM mainframe for the use of the primary administrative systems. On an annual basis, the central Operating Budget would buy a share of the mainframe's overall CPU capacity, disk and tape storage, and printing capacity. Instead of billing each client account for actual CPU seconds used, pages of print and megabytes of storage, the Provost, with Operating Budget funds, owns a percentage of these capacities and allocates them to the CORE clients (including the Registrar, Controller, Office of Development, Administrative Resources and the Libraries). The amount purchased would be based on historical usage and estimates of growth for existing function, plus some head space.

This concept met objectives #3 and #5 outlined above in that it is a reasonable cost recovery method under A-21 principles and it established the full cost to the Operating Budget well in advance providing the needed cost control. The only problem was that the funding to purchase a piece of the mainframe was in the individual CORE clients' budgets! In order to make the CORE concept possible it was necessary to pull these dollars out of the line organization budgets. This was also the key to making the CRAM management group work (objective # 1). Making them collectively responsible for the CORE budget would support their authority.

At Stanford very little is done by mandate. Thus, it was necessary to persuade the line managers that this plan was in their best interests as well as those of the Provost. This was accomplished by emphasizing the advantages of budget stabilization that would come from knowing in advance exactly what their computing costs would be for three years in advance. Plus, the line managers bought into the overall concept of optimizing local control for applications programming and central control of the Data Center budgets. Of course, the principal line managers, such as the Controller and the Registrar, who are owners of the large administrative systems are members of the CORE Resource Allocation

Management (CRAM) group. This gives them dual responsibility for both their own applications and for sharing in the management of the overall CORE capacity allocations and growth. Once these funds were centralized in the control of the CRAM group, objectives #1 and #4 outlined above were realized. Moving the applications programmers into the line organizations, ***where the funding was,*** and co-locating them with the line staff met objective #2. Figure 4 shows this realignment of the applications programmers to the line and the recentralization of the production computing budgets.

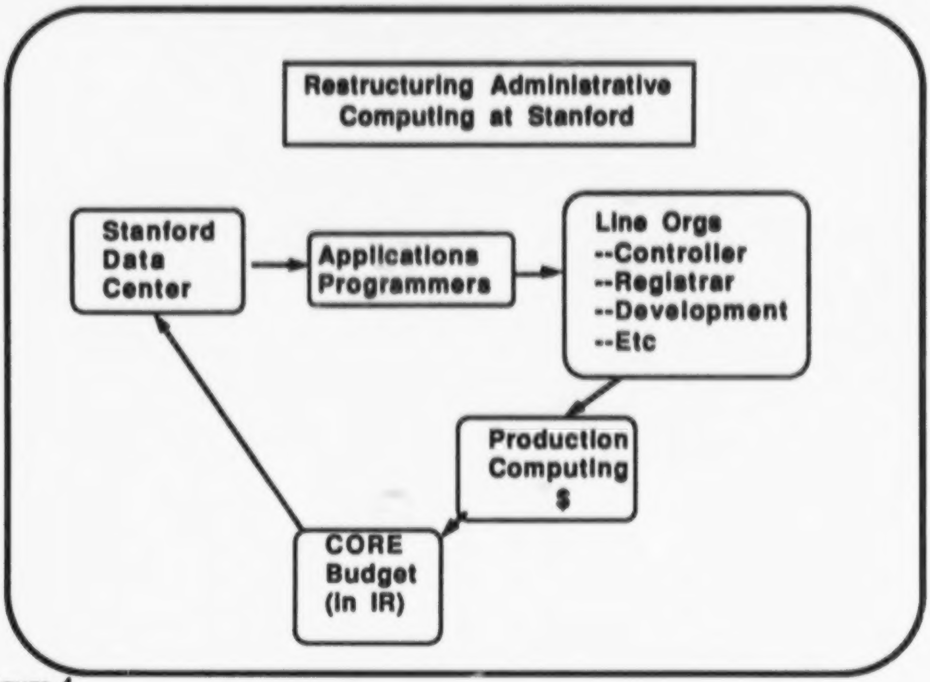
Restructuring Administrative Computing at Stanford
Stanford Data Center
Applications Programmers
Line Orgs
--Controller
--Registrar
--Development
--Etc
Production Computing $
CORE Budget (in IR)

Figure 4

VII. How Well Does the CORE Concept Work?

Administrative computing is now in a "controlled" growth pattern. Computing costs charged to the University Operating budget are expected to grow at about 12% per year (down considerably from years of more that 20%). However, because the Provost purchased a share of the mainframe, including some critical "headspace", actual growth in CPU usage for the CORE systems is expected to grow at an average 21% over the next three years. In addition, capacity forecasting has improved and Data Center equipment planning is better integrated with budget realities, supporting more realistic planning for mainframe upgrades. A consolidated three year plan has been prepared for all of the CORE applications, and, this year, the Data Center and CORE clients are making important advances in integrating user needs with technology planning through the applications plans.

VIII. Conclusions

There are many conclusions that could be drawn from the Stanford experience. As always, the financial strategies and organization structures need to fit the culture of the institution. However, given the context of this conference, we will try to summarize the important things we felt we learned. To some, these will seem extremely obvious. But, unfortunately, when you are surrounded by day-to-day problems and no one has or is willing to accept clear responsibility, very obvious things tend to be missed.

Following are the lessons we found most important:

1. Control both rate increases and total expenditures growth for service centers.

2. Include major clients as a part of the management structure for administrative computing.

3. Develop a financing strategy that allows this to happen.

In our case there were many parts to that financing strategy but perhaps the most important one was the partitioning of the machine and the upgrade strategy we chose to adopt.

Epilogue

As an epilogue to this paper, we would like to share some thoughts from a young economist who later went on to win the Nobel Prize for Economics. In a 1964 paper, "Research in Management Controls: A Critical Synthesis", Management Control: New Directions in Basic Research, Ken Arrow wrote down five circumstances under which charge-out structures (or transfer pricing as it was called in those days) do not work. We leave it to the reader to determine how many, if any, of the following apply to the Stanford situation.

Circumstances under which Charge-Out Structures do not Work

1. When consequences of the decision extend far into the future.
2. When the external world is changing, particularly when it is changing uncertainly.
3. Externalities (when the profitability of one part of the organization depends on the profitability of another).
4. When there exists large uncertainties in prices.
5. When managers are not performing well. (i.e., When they are not paying attention to revenue and expenditures.)

An Intensive Approach to Application Enhancement

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November 1989

Many institutions face an aging applications portfolio that demands much attention and many resources from information systems management and clients. These older applications are often caught in cycles where maintenance and operation become increasingly expensive, yet replacement costs are prohibitive. Efforts to meet constantly changing business needs are also straining many applications. In order to help support a major capital campaign, MIT chose a highly targeted and intensive approach to enhance an existing alumni/fund-raising/gifts system rather than replacing it. This paper discusses this project and projects of this type in general.

Introduction

As they head into the 1990s, many universities find themselves facing a common problem: a portfolio of business and administrative applications that are aging, difficult and expensive to maintain, and no longer meet the needs of the functions they support. This problem is not unique to universities, as corporations with custom applications (as opposed to relying predominantly on vendor packages) face the same issue. We presently find ourselves in an era when new tools and techniques to support the design and construction of applications are commonly available, yet most organizations still spend the vast majority of their programming resources on maintaining existing systems.

As an application ages, the real dollar cost to operate and maintain it usually increases each year. There are a number of reasons for this:

- As the application is changed by adding screens, modules, data elements, and the like, it becomes unwieldy, and its original architecture weakens to the point similar to a house of cards ready to collapse at the failure of one key component.
- As changes are made, technical documentation often is not updated, making maintenance more difficult by causing a divergence between the application and the documentation.
- As the underlying business processes of the organization evolve and change from those in place when the application was originally designed, the ability of the application to support changing functions decreases. Each succeeding functional change becomes more and more difficult to implement.

Most application support organizations face intense pressure from clients to keep up with their requests for changes. Many groups carefully monitor their backlog of requests but are seemingly unable to "keep their heads above water". This pressure forces many application changes to be done on a "quick fix" basis, without sufficient thought given to implications on the overall application architecture. These quick fixes often exacerbate the problem with older applications and make continued maintenance and operation more costly and difficult. This paper will describe a successful project to improve a major business application and extend its life by a targeted approach to breaking out of the typical costly maintenance cycle.

Background

The Massachusetts Institute of Technology (MIT), like most institutions, has an aging applications portfolio and spends most of its application support resources on maintaining these applications. With the exception of three relatively small systems which use vendor packages or service bureaus, all of MIT's administrative applications have been custom developed. During the last fiscal year (ending June 30, 1989), MIT spent more than $7 million to develop and maintain administrative applications, with 50% of this total spent on low-level maintenance. Many of these applications operate in the IBM mainframe environment and are more than ten years old, with an original architecture dating to the 1960s. While some of these applications have been converted to different operating systems over the years (DOS to VS1 to VM/CMS), their underlying designs have not been improved.

Most maintenance on these applications is done on a task-by-task basis, in which individual changes are implemented one at a time. The priority for maintenance tasks is established by the client, who responds to changes in business processes and functions. Changes to application databases are occasionally made, usually done on a task-by-task basis also. In some instances, this process results in the technological equivalent of a ramshackle shack which is now ugly (from a technical, functional, and user interface perspective), difficult to maintain, and in danger of collapse.

Over the last few years, MIT has decentralized the responsibility for support of approximately 50% of its administrative applications[1]. Applications can be developed or maintained in several ways: by programmers from Administrative Systems Development (ASD), the central applications development group; by programmers in client offices; by consultants from outside of the Institute; or by any combination of these.

One of the risks of decentralization, observed at MIT as well as at many other universities, is difficulty in creating and enforcing standards. With the responsibility for applications support reporting up through different line organizations, there is a good chance that common techniques, tools, and architectures will not be used. Unless some type of centralized review and authority over application support is established (by the central information technology organization, for example), the risk of standards being ignored is much greater. The lack of adherence to standards can exacerbate the maintenance problem described on page 1.

The Alumni, Donor, Development, and Schools System

In 1979, MIT developed an application to track all alumni and their gifts. The central application development group, working with the Alumni Association and the Treasurer's Office, developed the new system. The system uses the ADABAS database management system to maintain its data and the PL/I programming language for on-line and some batch functions.

Over the years, the system was maintained and enhanced to provide additional functionality as client needs changed. The central application group performed most of this maintenance on a task-by-task basis as described above, with little overall strategic direction. During this same period, the Alumni Association also established its own small group of programmers; the group focused primarily on writing management reports to track the various data about alumni and their gifts. In addition, this group developed a number of small subsystems that used some of the data in the main system.

In the mid-1980s, MIT began to formulate plans for a major capital campaign. These plans evolved into the Campaign for the Future, a $550 million, five-year campaign. As part of the plans, the Resource Development department more than doubled in size in order to manage campaign prospecting and solicitation. Part of this increase resulted from creating a small programming group to write management reports for the campaign. The staff of the Alumni Association also increased (though by a smaller magnitude) in order to enhance its efforts on annual giving.

By the campaign kickoff in 1987, the original alumni/gifts system had grown to become the Alumni, Donor, Development, and Schools (ADDS) system. Its purpose was to support the following groups:

- Alumni Association, responsible for alumni relations and annual giving
- Resource Development, responsible for researching, prospecting, and soliciting major gifts
- Treasurer's Office, responsible for recording the gifts
- development officers of the five schools at MIT, responsible for school-related solicitations

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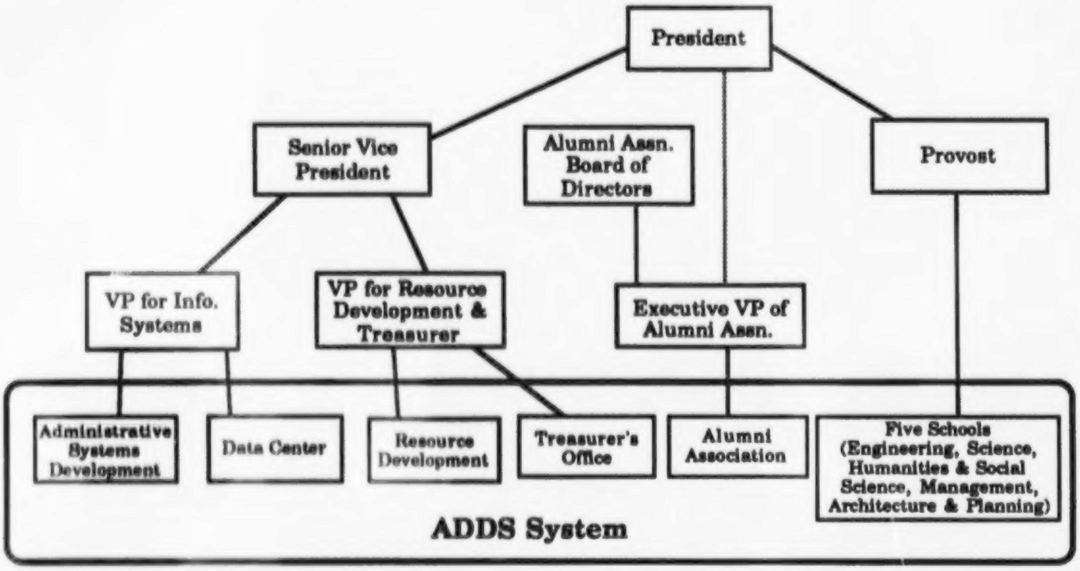
[1] For more on how MIT has decentralized application support, see Mary Ellen Bushnell and Donald E. Heller, "Application Development Services in a Competitive Environment", *CAUSE/EFFECT*, Fall 1989, p. 33.

The illustration below shows the relationship of the ADDS system to the various departments involved.


President
Senior Vice President
Alumni Assn. Board of Directors
Provost
VP for Info. Systems
VP for Resource Development & Treasurer
Executive VP of Alumni Assn.
Administrative Systems Development
Data Center
Resource Development
Treasurer's Office
Alumni Association
Five Schools (Engineering, Science, Humanities & Social Science, Management, Architecture & Planning)
ADDS System

The architecture, many of the programs, and much of the database structure of the ADDS system remained similar to the original system developed almost ten years earlier. A number of enhancements and modifications were made to support the campaign, but these primarily were added on top of the existing system, rather than being fully integrated into it. Some of these enhancements were actually new subsystems to track such entities as prospect information and campaign volunteers. Other enhancements involved writing reports (at this stage primarily using NATURAL, a 4th generation language) to support campaign researchers and solicitors. At the time, ASD and the client offices believed the system should last through the life of the campaign, even though it would be close to 15-years-old by the end of the campaign. ASD had two programmers supporting the ADDS system, with 60% of their time spent on maintaining the on-line system, and 40% on programming management reports.

With the campaign ready to begin, the ADDS system was being used by almost 200 different people in three administrative departments and five schools, with an average of 60 simultaneous users. During the most recent fiscal year, the system was used to record over 40,000 gifts and pledges with a total value exceeding $131 million. In addition, an average of 170 batch report jobs are run against the database each week. Many of us felt an omen was sent when the stock market dropped precipitously on Black Monday only three days before the official campaign kickoff in 1987.

The Problems Begin

With increased usage of the ADDS system following the campaign kickoff, both the clients and ASD staff began to notice some problems. Their observations included the following:

1. Response time for both the on-line portion of the system (used for entering and querying alumni biographical and gift information) and batch jobs (primarily management reports) was deteriorating. While this was partly due to the overall load on the IBM 3083 mainframe on which ADDS ran, some questions were raised about the performance of the ADDS system itself.

2. The mainframe costs associated with running the ADDS system were increasing rapidly and approached $1 million. Since the data center at MIT operates on a chargeback basis, the increased costs impacted the client operating budgets.
3. The user interface and functioning of the on-line portion of the system were awkward and inconsistent. Menu hierarchies and screen navigation rules forced users through many different screens in order to enter or query information.
4. Many of the programs were awkward and difficult to understand for the programmers maintaining the system. Over the years, some inefficient and unstructured programs had been written that tended to be "cloned" by subsequent programmers who needed to develop a similar function or report. In this way, inefficiencies and structural problems were perpetuated throughout the system.
5. The data structures were inefficient and in many cases did not support client business needs. Data elements and descriptors (keys) had been added to the database as needs arose, with no overall plan for or redesign of the database.

These observations raised concern over whether the ADDS system would in fact be able to support the Campaign for the Future during its remaining four years. We knew we could not implement a vendor package or develop a completely new system in the middle of the campaign without major disruptions. Even if the system did in fact last through the end of the campaign, people thought it could not be used much beyond that, if the campaign was extended beyond its original five-year duration (a common event in capital campaigns).

Because of these growing concerns, clients and Information Systems (the central information technology organization) decided in 1988 to conduct a study of the ADDS system, examining problems and possible solutions to ensure system usefulness throughout the life of the campaign. A decision was made to hire an independent consultant in order to bring the necessary expertise to the review process.

Review of the ADDS System

In September, 1988, MIT hired a consultant[2] to review the ADDS system and make recommendations for improving it. The consultant had a number of years of experience in applications development and had been a principal in a consulting firm specializing in ADABAS and NATURAL applications. He spent approximately six weeks meeting with clients and ASD staff as well as reviewing PL/I and NATURAL programs, the logical and physical design of the database, and system performance reports. The results of the study were presented to a group that included the vice president and department head of each of the areas involved with the ADDS system.

The key findings of the study, as summarized in the final report, were:

1. Programs and batch jobs are inefficient ... programs and jobs can be improved 10%–95% in execution speed by more structured design and programming techniques.
2. Programs, jobs and systems are difficult to understand and maintain .... almost all programs could benefit from improved structured design and programming techniques ... there is almost no technical documentation.
3. The database design is inefficient ... there are an excessive number of keys to the major files.... Compound keys to support the frequently used access paths do not exist ... there is no documentation about the design decisions made.

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[2] The names of the consulting firms used in this project are not given in order to avoid any appearance of an endorsement by MIT; this should not be construed, however, as a comment on their performance. More information is available from the author.

4. The user-interface of the on-line systems is inefficient.... The user must traverse through multiple screens to satisfy their information request where one screen would suffice.... The user cannot go directly from their current screen to the one they need next.... On-line help is rarely available
5. Finding problems and determining their cause(s) is difficult and time-consuming ... determining how often programs are run is difficult or impossible ... determining which database files are accessed, how they are accessed and how often is difficult and expensive. There are over 40 NATURAL libraries containing over 4,500 programs ... only 1200–2000 are used in production.[3]

In order to eliminate or alleviate these problems, the report made the following recommendations:

1. Proceed with a project (the "ADDS Efficiency Project") to improve the systems, practices, and procedures related to the ADDS database.
2. Hire a full-time Data Administrator to manage the ADDS systems and the improvement project.
3. Provide training to all ADDS development personnel in structured design and programming.[4]

The major benefits of undertaking this project would be to improve the performance efficiency of the ADDS system, reduce or control the growth of application maintenance and support costs, and most importantly, ensure that the system would last for the duration of the Campaign for the Future. The major incremental costs (beyond resources already dedicated to the ADDS system) would be the cost of the data administrator and the additional resources for accomplishing the report recommendations.

The Search for a Data Administrator

Among the complexities of the ADDS system are that it directly supports three major departments and that the technical support is provided by three different departments (see diagram page 3). Because of this, governance of the system is relegated to a series of committees, summarized in the table below.

Committees with members	Responsibility
ADDS Management Group Director, ASD Director, Alumni Information Management Director, Campaign Systems Recording Secretary Data Coordinator, Sloan School	• Set policy • Long-range planning • Resolve differences between the Technical Group and the Operations Group
ADDS Technical Group Director, Alumni Information Management (chair) Technical staff from ASD, Alumni, and Resource Development Area Manager, ASD	• Establish programming standards • Review file structures • Determine ways to implement changes requested by the Operations Group
ADDS Operations Group Director, Campaign Systems (chair) Users from Alumni, Resource Development, Treasurer's Office, and Schools Area Manager, ASD	• Discuss requested changes, performance problems, and other factors affecting users

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[3] "Management Report: MIT ADDS Database Systems Efficiency Evaluation", internal MIT report, October 1988, pp. 6–8.

[4] Ibid. p. 12.

During discussions about hiring a data administrator to assume overall responsibility for the ADDS system and the ADDS Efficiency Project (AEP), it became clear that a consensus did not exist regarding which organization should supervise the data administrator in a reporting relationship. In addition, the question was raised whether a qualified data administrator could be retained once the AEP was complete and a more stable operating environment was achieved.

Because of these concerns, the decision was made to hire a consultant to act as the data administrator and to lead the AEP for its estimated duration of twelve months. The consultant would be funded by and would report directly to the Director of ASD, with a responsibility for coordinating his or her work with the three groups that govern the ADDS system.

In December 1988, a Request for Proposal was written and distributed to twelve organizations around the country. The request contained excerpts from the ADDS study and asked for proposals for providing data administration services. The organizations solicited ranged from Big 8 accounting firms to small, specialized information technology consultants. Proposals were received from seven companies, and after an initial review by the Director of ASD, two were eliminated because they did not meet the minimum requirements stated in the request. The remaining five proposals (which ranged in cost from approximately $94,000 to $219,000) were distributed to the members of the ADDS Management Group. Another proposal was eliminated in this process and the remaining four firms were invited to MIT to present their proposals.

The presentations were conducted in January 1989, and the winning proposal was selected unanimously. The contract award was based on three factors:

- qualifications and reputation of the contracting firm and of the individual proposed as data administrator
- description of the services to be provided
- proposed cost

The winning proposal was the second lowest in cost of the four finalists. A one-year contract with the firm was negotiated and signed, and the data administrator began working in February 1989.

The ADDS Efficiency Project

A project team was formed for the AEP. Under the direction of the data administrator, members included two senior level and one mid-level analyst programmers and one technical writer, all from ASD. In addition, a manager from ASD also was involved on a day-to-day basis with the project. The AEP team would work closely with programming staffs from the Alumni Association and Resource Development, though the AEP team would not have direct authority over their work. All parties acknowledged that, while programmers from the client departments would be involved in the AEP, the majority of their work would have to continue to support the on-going operations of the campaign.

The first task of the AEP team was to review the ADDS study report and to develop a project plan outlining the work to be conducted over the following twelve months. The project plan was completed and reviewed with the ADDS clients within about three weeks. The major activities of the project fell into the following three categories:

- Analysis and redesign of the production database files
- Analysis and reprogramming of the large, frequently-run batch reports
- Analysis, redesign, and reprogramming of the on-line portions of the system

In addition to these activities, education and training of the technical staffs supporting the system were to be addressed by the project. This was done through a variety of mechanisms: informal training sessions about the ADDS system and its data targeted at users; sessions about specific programming topics led by the data administrator and targeted at client programmers; and formal workshops on various aspects of ADABAS and NATURAL programming led by an outside training firm.

The AEP was scheduled to last for twelve months, through February 1990. To allow for any changes that may occur during the life of the project, the schedule set the completion date for the final task approximately ten months into the project, thus allowing for contingency time of 15%.

As noted on page 4, one of the critical problems with the existing system was the lack of standards supporting the maintenance of the ADDS system. Consequently, one of the project's first activities was to establish standards for the maintenance and documentation of the ADDS system. The consulting firm selected to provide the data administrator was well-respected for its work with ADABAS and NATURAL environments, including establishing specific programming standards. The AEP team wisely decided early on to adopt these standards as the basis for much of the work to be done.

Analysis and Redesign of the Database

As described on page 4, an overall plan for implementing changes to the database files in the ADDS system did not exist prior to the initiation of the AEP. In the past, when an office needed a field added to one of the files, it was usually added to the end of the file because this was the easiest and fastest way to make the change. This solution was used because of the quick turnaround time required by the clients and the workload of the database analysts. Often there was insufficient time to conduct an analysis of the change and its impact, in order to develop the most efficient and effective solution. Requests for new keys for the file usually occurred in a similar manner, without reviewing whether existing keys could be combined or otherwise changed to meet client needs. In addition, database problems were made worse because virtually no reviews were conducted to determine whether unused or underused fields and keys could be eliminated. At no point were real attempts made to truly normalize the data.

Compounding problems with the database itself were the numbers of new programmers and users added in the client departments over the previous few years. For the most part, both users and programmers were not provided with enough training to give them sufficient knowledge of the data and their uses in order to do their jobs effectively. Without a thorough understanding of the logical and physical database design, as well as adequate technical training, programmers could not structure programs to make the most effective use of the data and of machine resources. Similarly, users who did not understand the data often did not know how to accurately formulate requests for information.

In order to evaluate current database use, the AEP team worked with the database analysts in ASD to collect information about patterns and frequency of use of the files, fields, and keys. The team analyzed the usage patterns through an iterative process; they reviewed this information with the clients to determine possible changes. Early in the project, it was decided to combine all of the recommendations into a major restructuring of the database in order to minimize the impact on the clients.

After a thorough review and analysis of the database, the AEP team developed a list of changes. The list included the removal of 100 fields (16% of the total fields in the 14 affected files) and 101 keys (41% of the total keys in those files). These changes were scheduled for implementation in the summer, after clients had concluded processing to close the fiscal year.

Analysis and Reprogramming of Batch Report Jobs

The ADDS system was used most frequently to produce various types of reports for the management, researchers, and fund raisers in Resource Development and the Alumni Association. The most pressing problem was that jobs were taking too long to run, even during overnight batch processing. In February 1989, the IBM 3083 mainframe on which the ADDS system ran was upgraded to an IBM 3090, providing roughly twice the computing power. While this provided short-term improvement, database users were concerned that problems might resurface later when the 3090 became busier. Thus, the AEP team was charged with examining the report programs to see if they could be made more efficient.

This task was a difficult one, because there were literally thousands of programs in scores of libraries. The AEP team embarked on a process of identifying key tactical improvements that could be made to selected programs. They accomplished this by analyzing the performance of jobs run against the ADDS database and their resource utilization as measured by physical input/output calls and database transactions. A weekly list of the most resource-intensive jobs (fondly referred to as the "chugger" list) was created in order to track which jobs were using the most resources and were run most frequently.

Once these key jobs were identified, the data administrator met with the programmer responsible for each job. They examined the programs, and suggested and tested methods of improving the performance efficiency of the programs. The revised programs were tested to measure their resource usage. The results showed that some of the most resource-intensive jobs could be reduced by more than 75% in both run time and resource utilization. Since many of these report programs had been cloned, fixing one program often led to changes that could be made quickly to others.

Analysis and Redesign of the On-Line System

The largest and most complex activity in the project was the analysis, redesign, and reprogramming of the on-line portions of the system. The major portions of the on-line system consisted of approximately 230 PL/I programs that were ten years old. These programs were divided into two main subsystems: BioEntry, used for the entry and display of biographical information about alumni, and GiftEntry, used for recording gifts and pledges made by alumni and others. Both subsystems were largely undocumented and often did not follow good software engineering techniques, resulting in difficult and expensive maintenance. A relatively simple request to change the layout of a screen became a major endeavor. In addition, because user interface standards were not used, inconsistencies in screen navigation rules and function key definitions existed.

Since the scope of the project was primarily to improve the performance and efficiency of the ADDS system, the project team did not set out initially to make major enhancements to system functionality. One of the first decisions made by the team, with the concurrence of the ADDS Technical Group, was to discard the PL/I programs in their entirety and reprogram the screens in NATURAL. Prototyping and testing demonstrated that existing programs could be replaced with NATURAL programs without any response time slowdown (and in fact some improvement). Previous experiences had shown that the time required to write programs in NATURAL was much less than for equivalent PL/I programs.

The AEP team began with the premise that it would simply copy the existing data entry and query screens and reprogram them in NATURAL. During prototyping, they received many requests for improvements to existing functionality. Most of the suggestions revolved around the screen navigation and function key definitions. During the iterative prototyping, the team determined that it could accommodate the requests of the users without delaying the project schedule. Thus, they decided to meet requests for new functionality from the users as long as the original schedule for reprogramming of the on-line systems could be maintained.

As described above, the existing ADDS system contained two main on-line subsystems. The original plan was to maintain the structure of two separate subsystems, with the reprogrammed GiftEntry subsystem put into production in August and the new BioEntry implemented in September. Prototyping allowed us to discover that the two could be combined into one subsystem to support both biographical and gift data entry and query functions. The combined subsystem would minimize the effort spent on reprogramming the screens and also would simplify future maintenance. The project team continued the iterative prototyping of the screens, taking into account the functionality improvements requested by users. A major revision to the technical and user documentation of the BioEntry and GiftEntry systems was done concurrently with the reprogramming effort.

Once design specifics were well-established, programming of the screens began. The existing 230 PL/I programs were to be replaced with 90 NATURAL programs. When the target dates for implementing the new subsystems were delayed until October, it became apparent that these changes and the scheduled implementation of database changes (described on page 7) were likely to occur approximately one month apart. Because the system would be closed down for a period of time for the production conversion with a resulting impact on clients, the AEP team and clients opted to implement both the database and on-line subsystem changes in one conversion. While a combined conversion would be more complex, a shorter period of impact for the clients was a more important consideration.

The work on both the database changes and replacement of the on-line subsystems continued; the implementation date for both activities was November 4, 1989.

Evaluation of the Project

The conversion of the database files and on-line subsystems was completed on schedule. The conversion required an intensive effort by a variety of parties:

- database analysts, who converted the actual database
- the AEP team, who installed the new version of the on-line screens
- the client programmers, who installed the subsystems they were responsible for converting to the new database formats
- the users, who conducted all of the testing after the conversion

The system was shut down for two business days to accomplish the conversion. With very few minor exceptions, all converted programs were implemented successfully without any bugs.

As the deadline for this paper approached, we are still evaluating the performance improvements of the new database structure and on-line programs. Some of the improvements already noted include:

- a 25% reduction in disk storage for the fourteen files affected by the database changes
- an improvement in response time for both on-line functions and batch report jobs
- a large degree of user satisfaction in response to the simpler screen navigation and function keys in the new on-line subsystem, leading to increases in user productivity

Data on the total resource usage and response times for both on-line subsystems and batch jobs will be collected over the next few months and compared to preconversion data. So far it appears that both resource usage and response times have decreased, but we will make a formal conclusion when more concrete data are available.

One of the difficulties in evaluating this project is the number of factors affecting resource utilization, production costs, and response time. For example, one of the concerns described on page 4 was production costs of $1 million annually for running the ADDS system. Since a major goal of the project was to improve performance efficiency, a performance measure could be the production cost of the system before and after the conversion. A simple comparison of this type, however, assumes that the volume of activity in the ADDS system remains constant. If the volume increases (because of running more reports, making more queries, or recording more gifts, for example), you need to control for this in cost comparisons. While possible, this is a tedious and time-consuming task, given the size of the ADDS system, the large number of users, and the variety of jobs run. Thus, comparisons of resource utilization over time are difficult to make.

Summary

The current schedule of the project calls for the final report and recommendations to be completed on January 5, 1990. This is approximately two months earlier than the original twelve-month schedule, due primarily to not using the contingency time. Explicit project costs can be summarized as follows:

Contract with consulting firm for data administrator	$148,000
Addition of one full-time programmer and one half-time technical writer from ASD (above existing level of ADDS support) for ten months	96,000
Total	$244,000

The total does not include costs associated with time spent by the programmers in client offices for work done on enhancing client subsystems and batch jobs. While these costs were not tracked separately, they are believed not to be large since none of the clients added additional staff exclusively for this effort. The programming staffs of both the Alumni Association and Resource Development were able to continue to meet the operating needs of the campaign during the entire project.

As mentioned above, the quantitative benefits of this project still need to be calculated. We do know, however, that the following results have been achieved:

- The useful life of the ADDS system has been extended to ensure that it can continue to meet the needs of the campaign workers.
- Current estimates are that the programming resources necessary for maintaining the on-line portion of the ADDS system in NATURAL will be half of what was necessary for PL/I program maintenance. Taken another way, twice as many tasks can be accomplished with the same resources. In addition, programmers joining the project will be productive more quickly because of the 4th generation language and structured techniques now used in the system.
- The functionality and user interface of the system have been vastly improved; users already have acknowledged this change.
- The improvements in batch report jobs have been noted earlier, and initial indications after the conversion are that on-line response time has improved also.

The decision to apply an intensive approach to enhancing the ADDS system appears to have been a wise one for MIT. By extending the life of the system and postponing the capital expense of replacing it, we have made resources available to address priorities in other areas. Other older applications at MIT are currently being examined to determine whether the same approach will yield similar benefits.

ALIGNING UNIVERSITY GOALS WITH INFORMATION SYSTEM STRATEGIES--

SMOKE AND MIRRORS?

Dennis L. Kramer
Director, Computing Services
Richard C. McKee
Assistant To President

Ball State University
Muncie, Indiana

Ball State University's president, vice presidents, provost, and leadership of information systems jointly completed an intensive study of information systems investments and the degree of alignment with the goals of the University. Objectives of the study were to improve the executive leadership's understanding of information system (IS) investments, determine the level of alignment of these investments with strategic University goals, and identify opportunities for shifting investment priorities to better support these goals. A 1988 study of critical MIS issues ranks aligning IS and corporate goals second in a list of twenty (behind using IS for competitive advantage). This paper describes the methodology, findings, and impact of the study at Ball State University.

ALIGNING UNIVERSITY GOALS WITH INFORMATION SYSTEM STRATEGIES--

SMOKE AND MIRRORS?

A recent study of critical management information systems issues ranks aligning information systems (IS) goals with corporate goals second in a list of twenty---first was the use of IS for competitive advantage. (CIO, January, 1989, p. 10) It has also been reported that average spending on information systems for 1989 would increase at a rate twice that of inflation, but that less than 10% of senior IS executives have found ways to measure the value of their information systems to the corporation. (CW, December 5, 1988, p. 20)

Ball State University's president, all vice presidents and the senior leaders in campus computing jointly completed an intensive study of computing investments and the degree of alignment with the goals of the institution. The study took approximately one month to complete, including data gathering, the analysis of university and computing goals and computing investments, and completing the final report.

Ball State University is a state-supported institution with over 19,000 students, 1200 faculty, and a computing services budget of $6,500,000. University Computing Services reports to the Office of the President and has responsibility for academic and administrative computing and data communications. Overall policy and planning is supported by four committees: President's Advisory Committee on University Computing (PAC), Academic Computing Committee, Administrative Computing Committee, and the Computing Resources Subcommittee of the University Senate. The University leadership has focused strategically on the application of computer, data communications and video technologies to enhance it's image, quality and competitive advantage.

A structured approach employed in this study was SIM (Strategic Investment Methodology), offered by IBM's Advanced Business Institute. SIM has been used in private enterprises in the United States and Europe, but Ball State University is the first institution of higher education to employ the methodology. President John E. Worthen was the executive sponsor of the study, appointing the participants, providing resources needed, and becoming an active participant. IBM provided senior consultants from the Advanced Business Institute and the technical resources that were required. Other participants are listed in Figure 1.

Objectives of the study included:
*Improve understanding by senior University officials of total computing investments throughout the campus.
*Relate computing investments to University goals, and identify over or under invested priorities.

WHO

EXECUTIVE TEAM

- VP BUSINESS AFFAIRS
- VP STUDENT AFFAIRS
- ASSISTANT TO PRESIDENT
- VP UNIVERSITY ADVANCEMENT
- PROVOST
- PRESIDENT, EXECUTIVE SPONSOR

FACILITATORS

IBM CONSULTANTS,
WHITE PLAINS, NY

PROJECT TEAM

- DIRECTOR OF FINANCE
- COORD. INFORMATION SYSTEMS
- DIRECTOR COMPUTING SERVICES
- ASSOC. DIR., COMPUTING SVCS.
- COLLEGE DEAN
- DIR. ANALYTICAL STUDIES/PLAN
- ASST. DIR. OF FINANCE
- IBM REPRESENTATIVE
- IBM SPECIAL INTERN

Figure 1--Participants

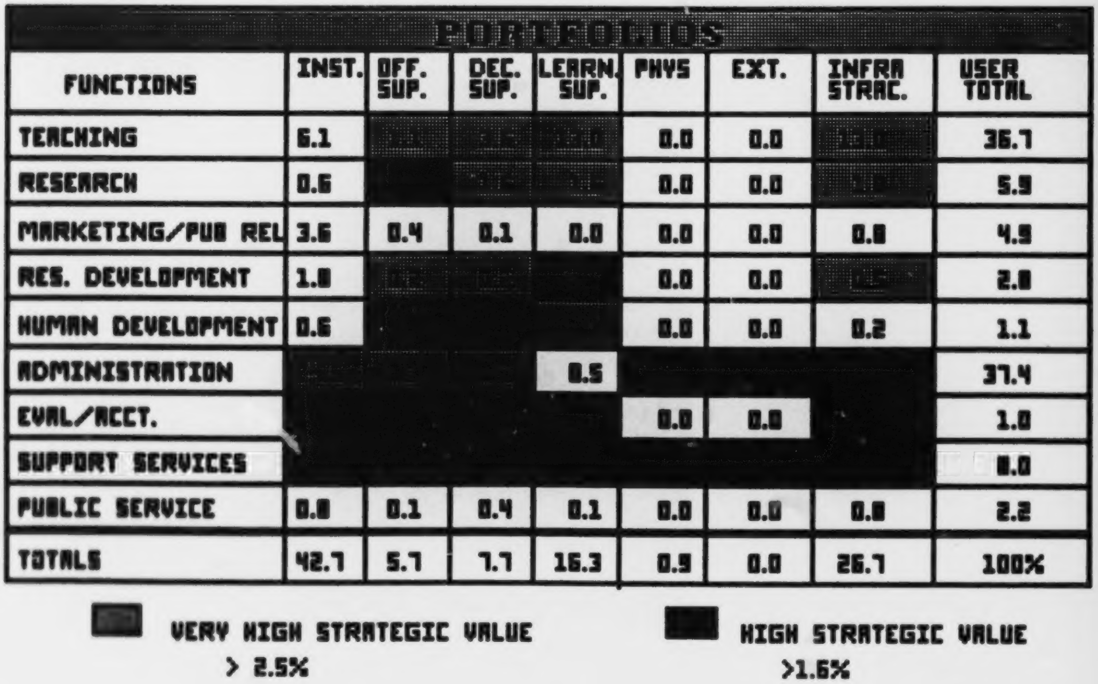
*Provide a system to determine the impact of changing University goals on computing resource allocations.
*Clarify and enhance communications between senior administrators and computing leadership.
*Develop action plans to improve alignment of computing investment with key University goals.

Computing investments must be measured not only in the computer center or traditional organization normally thought to contain this budget, but also in user areas throughout campus. User areas have workstations, personnel dedicated to computing, minicomputers, outside services, software, networking and maintenance that may be budgeted for separately from centralized services. Of course computer center budgets include investments (expenditures) for mainframes, minicomputers, personnel, networking, maintenance, outside services and software.

These investments are analyzed and categorized in a four quadrant grid according to the type of resource (i.e., personnel, network, computer, outside services, terminals, other), functions or uses (i.e., teaching, research, public services, marketing, administration, support), technology portfolios (learning support, decision support, office support, physical, infrastructure, institutional), and management approach (utility, venture, retail). Consensus techniques are used to weight University goals, rank functions, and determine which technology portfolios have the most potential to contribute to meeting the University's goals.

All this analysis is combined in Figure 2 that illustrates the percentage of computing investments made in the various user functions and technology portfolios, as well as the strategic values of each of the cells (as determined by the consensus ranking and weighting). It may be seen that the high strategic and very high strategic value cells are typically receiving the most investment; examples of exceptions are learning support/resource development, and external support/administration. User functions which could qualify for additional investment include research, evaluation/accountability, and support services. Technology portfolios to be targeted include office support and decision support. Close study of the chart indicates that the University is, by most indices, investing in high impact areas. Few cells were identified in which there was a low strategic weight and a high level of investment. While this indicates strength, it also is a limitation in that there are fewer "fat" (i.e., overinvested) cell from which resources can be reallocated.

Action plans were developed during the study and reviewed by the University Officials. President Worthen has referred future study activities to the President's Advisory Committee.



PORTFOLIOS

FUNCTIONS	INST.	OFF. SUP.	DEC. SUP.	LEARN. SUP.	PHYS	EXT.	INFRA STRAC.	USER TOTAL
TEACHING	6.1	[illegible]	[illegible]	[illegible]	0.0	0.0	[illegible]	36.7
RESEARCH	0.6	[illegible]	[illegible]	[illegible]	0.0	0.0	[illegible]	5.9
MARKETING/PUB REL	3.6	0.4	0.1	0.0	0.0	0.0	0.8	4.9
RES. DEVELOPMENT	1.8	[illegible]	[illegible]	[illegible]	0.0	0.0	[illegible]	2.8
HUMAN DEVELOPMENT	0.6	[illegible]	[illegible]	[illegible]	0.0	0.0	0.2	1.1
ADMINISTRATION	[illegible]	[illegible]	[illegible]	0.5	[illegible]	[illegible]	[illegible]	37.4
EVAL/ACCT.	[illegible]	[illegible]	[illegible]	[illegible]	0.0	0.0	[illegible]	1.0
SUPPORT SERVICES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8.0
PUBLIC SERVICE	0.8	0.1	0.4	0.1	0.0	0.0	0.8	2.2
TOTALS	42.7	5.7	7.7	16.3	0.9	0.0	26.7	100%

▨ VERY HIGH STRATEGIC VALUE > 2.5%

■ HIGH STRATEGIC VALUE >1.6%

Figure 2--Analysis

MANAGING COMPUTER SUPPORT COSTS THROUGH EFFECTIVE USER TRAINING:

Lessons Learned at the University of New Hampshire

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Given the rising costs of technology, directors of computing must look for cost-effective and efficient means of providing support to users. Yet, how can the computer services department provide cost-effective support to an increasing number of users with an ever-broadening spectrum of needs? One answer has been to create hardware and software standards. Yet, even with standardization, changes in personnel, upgrades to hardware and software, and the availability of new technology necessitate a long-term approach to providing computer support. At the University of New Hampshire, we believe that the one of the most cost-effective means of providing support to users is through effective user training. This paper presents the University of New Hampshire's approach to user training and argues that, among the investments a computer services department can make, training can actually have one of the biggest payoffs.

Introduction

As the discrepancy grows between computing budgets and other ways to spend limited campus dollars, computer center directors are having an increasingly difficult time justifying the high costs of computing. At a recent conference of high-level University administrators, a number of University financial officers indicated that 5% of their annual budgets was being spent on computing. This number went as high as 10% for those Universities that had undertaken a significant campuswide networking effort.

Along with the rising costs of computing, the number of computer users on campus continues to increase, and the profile of the computer user is changing. Many users have a growing comfort level with technology, a greater awareness of the possibilities offered by computers, and a growing demand for increased computerization. Still others feel pressured to begin using computers in spite of their continued fear of technology. The computer services department must be responsive to these changes. Yet, the computer services staff is not growing. How does the computer services department support an increasing number of users and changing institutional needs in a rapidly changing computer environment?

One answer which is often overlooked is to provide effective training. Many computer center directors consider training as an investment with less payoff than adding additional hardware, software, or support staff. At the University of New Hampshire, however, we believe that among the investments a computer services department can make, effective training can actually have one of the biggest payoffs.

The Importance of Training to the Institution

New technology continues to alter not only the teaching and learning aspects of an institution, but also its administrative capabilities. Adequate training is absolutely necessary if institutions are to take advantage of this rapidly changing technology. People must have the skills necessary to work with new technology and its associated software systems. Training is therefore beginning to emerge as one of the most important functions of campus computing. However, training individuals to use computers is difficult because of rapid changes in the field and because of the variety of uses to which computers are put in a large post-secondary institution. The institution must therefore be committed to significant training for all users,--faculty, staff, and students. At the University of New Hampshire, it is our view that training for computing is a key factor in providing the support needed to keep users ahead of technology.

If we were to look at a cross section of post-secondary institutions today, we would find they tend to approach training differently based on how important they view the training function. They may simply "muddle through" with little or no training, they may do "reactive" training in response to problems or as specific needs arise, or they may actually have a planning process for training just as they plan for the acquisition and use of technology.

Much of the training for computing in higher education has not been particularly effective, partly because technology has developed so fast. Existing training models have not coped well with the changing technology. Moreover, as the computer experience of faculty, staff, and students increases, so do their training needs. Training must shift from basic literacy to more selective training for particular skills. What then are the elements necessary to provide effective training?

Factors Affecting the Success of Training

Some of the elements of good training are fairly obvious. Others are not so obvious. One of the first things to assess in an effort to design a training program that will provide adequate support to users is the goals of that training program. In order for training to be a part of the overall support infrastructure of the computing department it must go beyond merely teaching skills for using a particular software package or solving operational problems. Although these are important and necessary goals, training must also include the goals of increasing the productivity and quality of work and of creating an environment of teamwork where users work together more effectively.

If the goals of training are viewed in this larger perspective, a number of cost-saving benefits can result including:

- Making it easier to introduce changes and use new technology;
- Reducing costs associated with errors, rework, or down time;
- Reducing learning time for new employees;
- Doing more with the same number of people.

On the other hand, inadequate training can lead to costly delays, problems, and dissatisfaction on the part of users. One way to cost-justify training might be to consider the cost of not training. According to one recent article, corporations can waste as much as $740,000 per 1000 installed PCs if they don't teach people how to use them. (Information Center, November 1989, p. 28.)

Timing is crucial for training to be effective. Don't wait for problems to arise. Schedule adequate training before implementing changes. At the same time, training must satisfy a need or it will not be retained. For example, administrative users trained in how to use a new on-line administrative system months before the system will actually be in full operation will have forgotten most, if not all, of what they have learned by the time the system is fully functioning.

You must also ask yourself what delivery method will work the best. Not all users learn in the same way. For some, one-on-one training is most effective. For others, self-study packages will work best. Generally, less experienced users learn best with one-on-one training sessions or small hands-on workshops. More experienced users can learn effectively with self-study packages which might include documentation, video tapes, or computer-based-training (CBT) exercises. These forms of training allow the more advanced learner to skip areas they are already familiar with or go faster than a classroom presentation might allow them to. In general, training should include a balance between skills-based training and knowledge-based training. However, the emphasis on skills, or the "how to" aspects of training, should probably be emphasized early on so that the user may see results before becoming discouraged. Understanding the concepts will be easier after at least a short period of doing.

Training should also be geared to specific work groups, that is, to groups where people share similar job functions and, therefore, similar problems. An example of a training model that did not work well at the University of New Hampshire was an attempt to teach a word-processing course to a class open to both faculty and staff. These two groups, in fact, use word processors in very different ways. The faculty were more interested in learning how to do such things as footnotes and bibliography entries, while the administrative users wanted to learn how to produce mailing labels or use the word processor's mail-merge function.

It is also important, although not always possible, to try not to mix skill levels. If class sizes do not permit having a beginning, intermediate, and advanced section of a particular course, be sure to have have plenty of examples and exercises for more advanced users to work on while you are helping less-experienced users.

Encouraging Users to Take Advantage of Training

In order for training to serve as effective support, thus reducing support needs in other areas, users must take advantage of the training available to them. One method of making sure users take advantage of training courses is to make them required. This is not necessarily the most effective way to assure that users will benefit from training, however, since training will not be effective if it does not satisfy an immediate need. Training courses must often be scheduled far in advance due to limited classroom facilities and the availability of instructors. For this reason, courses may not be offered at the most appropriate time for users. Requiring someone to take a training course for a product they will not be using immediately will not eliminate their need for support later on.

Another, better way to encourage users to attend training sessions is to make them as easily-accessible as possible. One way to accomplish this is to provide in-class, or in-office, training for users at the request of faculty members or administrators. Another is to provide regularly scheduled "walk-in" training sessions so that when users develop a particular need, they can get immediate, and therefore, more effective training support. Video tapes of training sessions, whether "home-grown" or commercial, are another way to make training more immediate since users may view them when, and as often as, they like.

In all cases, training must be marketed to the user if the user is to take advantage of it. Marketing efforts for training can take the form of published schedules announcing monthly course offerings, newsletters or flyers announcing special training sessions of particular interest, or announcements in the institution's newspaper under a "notices" or "calendar of events" column.

Another way to make training attractive to users is to make the registration process as easy as possible. At the University of New Hampshire, users can call one central phone number to register or, if they prefer, can register for courses on-line. If on-line registration is used it must be well thought out so that it is both easy to use and up-to-date. Nothing will discourage a user from future training more than showing up for a class which was canceled but for which no information to that effect appeared in the on-line registration schedule. Thus, if on-line registration is used, it must be easy for the user to register, cancel, or reschedule and equally easy for those maintaining the on-line registration program to notify those registered of changes or cancellations.

Evaluating Training

An important, and often overlooked, factor affecting the success of training in providing effective support to users is that of assessment. For training to be effective, it must be seen as an on-going process which begins with a determination of institutional and individual needs, involves both users and trainers in the planning process, and includes procedures for evaluating the effectiveness of the training and making changes and adjustments as needed.

One way of evaluating the success of a particular training effort is to have users fill out a course evaluation form following the training session. This is an effective means of fine-tuning individual training programs. It is also a means of determining specific areas for which adequate training is not being provided. It will not provide much information, however, on some of the questions which those responsible for training need to consider if training is truly to be a part of the computer services department's support function. Some of these questions might be: Does the training make the user more self-sufficient? Does it make the user more efficient at his or her job? Does it provide a more cost-effective means of support to users than other types of support?

In order to address some of these larger training issues, the University of New Hampshire conducted a survey of both academic and administrative users of personal computers in the Spring of 1989. The goal of this surveying effort, called *Project PC Literacy,* was to determine what hardware and software were being used by users, how much users knew about support available to them on campus for hardware and software products, what hardware and software purchases were planned by users for the upcoming year, how important computing was to the user in performing his or her job, and what support, in what form, users felt they would like to have.

A total of 104 departments were surveyed as well as full and part-time faculty. The department survey took the form of a half-hour meeting to discuss computer services the department had used, an evaluation of those services, and discussion of services the department had not used or was not aware of. Departments were also asked about their future computing needs. After the meeting, an inventory of the department's microcomputing hardware and software was taken. At the same time, a two-page survey was sent to all full and part-time faculty. The survey asked faculty what microcomputer hardware and software they used, what computing services they used, didn't use, or didn't know about, and how they evaluated training and support services available to them. To encourage faculty to return surveys, all those who completed and returned their surveys were entered in a drawing for a gift certificate to the campus computer store.

The results of this survey were very revealing and resulted in a number of changes in microcomputer training and support offered at the University. Some examples include: the offering of evening courses for faculty; the publicizing of our on-line "questions" mailbox, which many users asked for but were unaware of the existence of; and the expanded use of regularly scheduled "walk-in" training sessions for users. In addition, we learned that some of the most successful forms of training we provided, might not be considered "training" in the traditional sense of the word. These were things such as our one-page, "how to" documents and our Faculty Resource Library, both of which allow users to "help themselves" to training as they see fit.

Training for Academic Computing

The training function for academic computing at the University is part of the department of *Computing and Information Services* and falls specifically under the responsibility of the Manager of User Support. Four areas in the User Support group which provide different forms of training are: the User Support Center, the Faculty Resource Library, the Desktop Publishing Center, and the Training Center.

The User Support Center was set up two years ago in response to user complaints that they were unsure where to go to get answers to computing questions. The Center is the first place for faculty and students to go for help with any computing question. If a user needs help with software, hardware, or any other computing information, a member of the User Support Center will either answer the question directly or refer the user to a consultant responsible for small or large systems support. These consultants are located either in the Center itself, or in offices adjacent to it. At the User Support Center there are a number of "self-help" training and support facilities such as a library of trade journals and a selection of one-page, "how to" documents on such topics as: *Getting started with BITNET*, *How to protect your work*, and *Installing WordPerfect 5.0*. There is also a Media Conversion Center with self-help guides to help users convert data files between MS-DOS, Macintosh, NorthStar, CP/M, or VAX computers. Users can also transfer information between 5 1/4" and 3 1/2" MS-DOS disks there.

The Faculty Resource Library and Desktop Publishing Center are two other learning environments which are particularly attractive to the more sophisticated academic user. In both centers, faculty may sit down by themselves, try new software, and ask for help from consultants when they have a problem. One-on-one training is available by appointment on the use of all software and hardware available in the centers.

The Training Center is located near the User Support Center and is used for training of both academic and administrative users. There are three classrooms at the Training Center tailored to the training needs of faculty, staff, and students. They provide projection equipment, microcomputers, and terminals which allow trainers to include either classroom demonstrations, hands-on training, or a combination of both, as appropriate. As part of the overall training effort, the Training Center offers regularly scheduled short courses on such popular topics as WordPerfect and dBASE III. Many of these courses are also available on videotape for viewing at the user's convenience. These tapes may be checked out for viewing on- or off-campus. There are also a number of commercial tapes, many of which incorporate software for hands-on exercises and self-paced learning.

The Training Center also provides projection equipment and computers for use in classrooms. Training Center personnel will deliver equipment to the classroom and set it up. Arrangements can also be made for extended-use setups. Each piece of loaned equipment is labeled with a hotline phone number to call if there is an equipment problem.

The Cost-Saving Benefits of Effective Training

As the above examples show, effective training can take on a number of different forms, not all of which take place in the traditional classroom environment with an instructor. Documentation, software packages, and video tapes can provide adequate and cost-effective training for certain user needs. In order for training to be successful and, at the same time, provide a cost-effective means of support for users, it must be evaluated carefully and tailored to both institutional and individual needs. The goals of the overall support function of the computer services department must be taken into account, as well as the resources available for the training function.

With careful planning, implementation, and evaluation, a number of cost-saving benefits to the overall support effort will result. These include:

- Teaching users how to do things for themselves rather than having the computer services staff do things for them;
- Enhancing the personal productivity of faculty and staff;
- Reducing the time spent on problems and crises;
- Reducing the time needed to install and maintain user systems;
- Decreasing departmental "downtime" resulting from turnover;
- Reducing lost productivity due to the learning curve associated with the implementation of new systems;
- Reducing risk of loss by educating end users on data integrity and security.

Recognizing that one of the best ways to manage support costs is by developing effective training, we will now turn to a case study of one training model developed at the University of New Hampshire. The following example of a training effort for administrative computing at the University of New Hampshire presents a model that has not only proved to be more successful in providing support to users than previous efforts but, at the same time, is among the most cost-effective training models used to date at the University.

A Case Study in Training For Administrative Computing

The University System of New Hampshire (USNH) is comprised of four campuses: Keene State, Plymouth State, University of New Hampshire Durham, and University of New Hampshire Manchester, and a state-wide adult education school called the School for Lifelong Learning. USNH Computer Services (USNHCS) is the organization that provides the administrative computing support for financial accounting, human resources, and student administration. Computer Services is located on the Durham campus and is connected to the other locations via a combination of leased and dial-up telephone services. Each campus has its own computing organization that operates independently from Computer Services, but these computing organizations support primarily instructional and research computing.

The Opportunity

The University System implemented a financial accounting system in Fiscal Year 1987. The new system was a well-known and successful software package, but this was the first implementation in a VAX VMS environment for a large University System. The implementation was a disaster due to many factors, and the University System was in serious trouble. The financial system allowed for a distributed entry of many documents,--purchase requisitions, budget transfers, payment vouchers, internal purchase orders. This distributed processing concept was a step forward in the effective use of automated systems, but it required a corresponding leap forward in the amount and quality of training.

The entry of the financial documents was a very intimidating responsibility for many of the staff of the University System. The staff required to do the work was primarily department secretaries, most of whom, had never before interacted with a computer. A few attempts were made to provide training, but no trainers were available to provide assistance for spur-of-the-moment questions, nor were there continuing classes presented to train new staff. The task of training the end users was given to the Controller's Office staff who had all that they could do to address a multitude of implementation problems and no time to assist the end user with training. The detrimental effect was dramatic; the situation caused a tremendous amount of frustration and many of the clerical staff resigned as a result. To describe the situation as chaotic would be only a slight exaggeration.

The Challenge

It was crucial to initiate a quality, timely, and comprehensive training capability. The training model would need to account for a widely dispersed audience. As earlier stated, USNH Computer Services served users in several locations in New Hampshire. To add to the problem, the training model could not include an increase in staff. Further, the University System was in crisis and something had to be done immediately; speed was essential and a lengthy preparation process was not acceptable.

The Model

The central theme of this case study deals with cost-effective means to provide training support to end users. The previous discussion on administrative computing presents the situation that occurred to precipitate action by the Computer Services organization to provide training to its end users within the constraints of existing resources and staff. The model that developed was based upon the following fundamentals:

1. In order to increase the number of trainers in the Computer Services organization, group all the functions that provide direct services to end users into one User Services department and designate all staff as trainers.

2. The number of professional trainers will be limited, therefore, leverage the skills of these few through support of a large group of non-professional trainers.

3. Quality documentation is an effective form of training.

User Services

The definition of User Services should be viewed as a broad concept. The functions of Production Services, Quality Assurance, Data Security, User Accounts, Technical Writing, Information Center, Consulting, and Training are consolidated into the User Services department. Each staff member, regardless of their speciality, is designated as a trainer and expected to provide end-user training.

The experience at the University indicates that the staff is not only willing to perform the added task of trainer, but that it is a welcome relief from their normal responsibilities. Over time, each staff member will develop a particular area of expertise and, in some cases, surpass the knowledge of the primary trainer.

At UNH, this practice of designating all User Services personnel as trainers, is also extended to phone support. The objective is to ensure that the telephone will always be answered quickly during the business hours of 8:00 a.m. to 5:00 p.m. Everyone is expected to provide phone support and the phones must be covered. The delivery of service is paramount and it is unacceptable for any staff member, including the department manager, to consider themselves exempt from the function of training and phone support. This approach to user service allows for the development of a critical mass of personnel that is able to provide consistent and effective delivery of training and telephone support.

Non-professional Trainers

The user community serviced by USNH Computer Services has embraced the concept of end-user trainers. The professional trainers in Computer Services promote the idea that their primary function is to train the end-user trainers who, in turn, provide front line training to a particular department or division. The ideal would be that the USNHCS trainer support only the end-user trainers, but, in practice, this is not possible. Many departments have trainers who are not effective and some have none at all. The USNHCS trainer must prepare training exercises for both the end users and the end-user trainer. The fact that this "train the trainer" model is not 100% effective does not invalidate the concept. The goal is to provide cost-effective training, and, if the number of end users to be trained is halved because of effective end-user trainers, fewer professional trainers are necessary.

It takes a significant effort to recruit end-user trainers and, once recruited, to keep them involved. It is important to establish an end-user trainer committee that meets periodically to share information and receive updated training assistance from USNHCS. This committee is particularly important to those end users that are representing remote campuses. (Keene State and Plymouth State are each 90 miles from the Durham campus of UNH.) Poor training practices and inconsistent or incorrect information will result unless the end-user trainers are frequently updated with current data. The onus is on the computer services staff to encourage an active and interested user trainer committee. The user trainers all have a primary function to perform. Training is a secondary responsibility and interest will decline unless they are provided with regular stimulation from computer services. To kindle this interest takes a significant amount of time and effort but the results are worthwhile.

Quality Documentation

An excellent method for reducing reliance upon direct end-user training is useful documentation. Effective documentation is elusive; the initial effort to prepare quality materials is very time-consuming. Obviously, the content of training manuals is important; not so obvious is the need for an effective format for the documentation. Regardless of how well the narrative is written, if it is delivered to the end users in a form that is not conducive to easy use, it will not be utilized and the efforts will be wasted. Our experience has shown that an effective format for training manuals requires the services of a professional technical writer/editor. The form is as important as the content and a quality form requires the services of a professional.

The approach that has proven to be effective for Computer Services requires that the end-user office develop the documentation narrative and User Services provides the editing and formatting. User Services employs a technical writer/editor to edit and format text developed by end users, to prepare documents for printing, to coordinate the printing with the printing services department, and to distribute the documentation to the appropriate end users. The technical writer/editor uses desktop publishing software (specifically, Aldus Pagemaker running on an Apple Macintosh computer) to prepare the documents for printing services. Fortunately, the Printing Services department at the University of New Hampshire acquired a photo composition/typesetting system that is compatible with documents prepared by Aldus Pagemaker, eliminating duplication of efforts.

Once the initial preparation is completed, the task of keeping the documentation current is also assumed by User Services. Effective updating of documentation can occur only when the initial effort has produced a manual that is designed for ease of maintenance. This is another argument in favor of having a professional involved from the start. If the initial effort produces a document that must be reprinted in its entirety each time an update occurs, the cost of printing and distributing the manual will be astronomical. Doing the job right at the start of the effort saves a significant amount over the useful life of the manual.

Part of every training exercise is the presentation of a User Guide to the staff being trained. The training will not only show how the automated system works but will also include instruction in the design and use of the User Guide. The objective is to have the end user become reliant upon the User Guide rather than the User Services Trainer. Nothing is ever completely successful, but if a large percentage of end users use the documentation, then the User Services Trainer can spend time on other responsibilities. Again, the objective is to leverage the skills of the professional trained with good documentation manuals.

The Impact

The USNH Computer Services organization has in excess of 1,000 end users located on four dispersed campuses, the University System offices at a fifth location, and eight locations for the School for Lifelong Learning. The User Services organization has two professional trainers and one technical writer/editor to serve this large and diverse user community. One of the trainers specializes in application systems,--financial accounting, student records, and human resources; the other trainer concentrates on technical products such as Fourth Generation Languages (Oracle and System 1032), Text Editors, Job Control utilities, and operating system commands. Each is capable of substituting for the other if needed.

A single technical writer/editor has excellent written communications skills and is thoroughly conversant in the use of Aldus Pagemaker for the Apple Macintosh computer. The content of all of the user documentation has been written by either the end user or one of our professional trainers. The technical writer has taken the narratives and transformed the prose into attractive, readable, well-organized, and easy-to-maintain documentation manuals.

The manuals have been updated frequently and remain as current today as when first created. The net impact of quality documentation on the ability of User Services to offer training will never be able to be measured accurately, but the fact that this large group of end users are well trained and very knowledgeable is testament to the success of the overall training model. The assumption is that the documentation is a major contributing factor to that success.

Case Study Summary

A monthly calendar of events is published to announce all courses for the next two months. User Services has developed an on-line course registration system that is easy to use and available to any Computer Services customer. Phone reservations are also received. In addition to the formal courses, User Services has periods set aside each week for introductory training for the major administrative systems. All new staff for the University System can be trained in the basics of any system the same week that they are employed. The "Drop-in Center" makes available a comfortable atmosphere for end users to stop into User Services for answers to questions or a quick training exercise. The emphasis is on friendly service to end users and "one-stop shopping" to meet all their needs. The techniques outlined in this paper have allowed USNH Computer Services to provide a quality and comprehensive training service with a very small staff. The primary elements of this training model are:

1. End user trainers to leverage the skill of the professional trainer.

2. Supplement training with quality end user documentation.

3. Combine all end user services into a single organization to provide a "critical mass" of staff, all of whom are expected to be trainers.

Lessons Learned at UNH

Training must not be considered a quick-fix, an add-on, or a "cookbook" approach to educating users. To be successful, training must be seen as a process to strengthen long-term institutional goals and performance, and as a cost-effective means of providing user support. Often, not enough time is spent up front assessing needs and planning the training effort, nor is enough time spent evaluating the results and making necessary changes.

Changes in personnel, upgrades to hardware and software, and the availability of new technology necessitate a long-term approach to providing computer support. Given the distributed nature of the equipment, the need for a strong centralized support organization, one that can coordinate training and other support functions, is essential. While knowledgeable end users will become an extension of centralized support, their jobs do not depend upon providing computer services. There must be an organization whose responsibility it is to coordinate training for all users. With proper planning and evaluating, however, training can be one of the most cost-effective and efficient means of providing computing support to users.

METHOD FOR PLANNING

ADMINISTRATIVE INFORMATION SYSTEMS DEVELOPMENT

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ABSTRACT

This paper describes the situation faced by universities in general, and Western in particular, in planning the development of administrative information systems. A methodology to assist decision-making with respect to the relative priorities of alternative (competing) projects has been developed and was applied for the first time in the 1989-90 fiscal year and is being continued for the 1990-91 fiscal year. The methodology is designed to identify the principal options for information systems development, and to permit the application of executive judgement as to the strategic importance of competing projects. The methodology itself and the rationale for its adoption are described. Our experience to date, and issues encountered and their resolution is also summarized.

ADMINISTRATIVE SYSTEMS PLANNING AT UNIVERSITIES

Planning the development of information systems is a challenging matter in most large organizations, and universities are no exception. Commonly experienced difficulties include the following:

- rapidly *evolving technology* changes both the nature of the work to performed and the tools available to do the work;
- the growth of *decentralized computing* using microcomputers and local-area networks creates rising expectations by the clientele to be served as well as multiplying the technical considerations;
- the *proliferation of client demands.* as computer applications increase both in number and importance points to the need for a general strategy and a need to involve more persons in the decision-making process;
- *a backlog of unfinished work.* It is common to have a large unfinished backlog of systems development work. Western is perhaps typical: the backlog of identified work amounts to approximately 3 years for a systems development staff complement of 20 positions. This situation creates frustration in client departments.

In addition to the commonly experienced difficulties, the organization of administrative processes in universities presents some special obstacles and considerations. These are:

- Administrative processes, and the information systems to support them, are regarded as *overhead activities of secondary importance* at universities, where the primary activities are teaching, research, and direct public service;
- *Funding is tightly constrained* in higher eduction and therefore new funds for administrative information systems are hard to obtain;
- *Increasing demands for administrative productivity* have been experienced with record enrolments, demands for new services, and requirements for information for government-mandated programs;
- *The need for participative decision-making,* due to tradition and the accountability of the university administration to a legislative-style decision-making system, and particularly in view of the fact that the end-users to be served by information systems are academic departments and students.

An important and simplifying factor in administrative information systems development at universities is that many (not all) of the important information systems are fairly stable in purpose and have, in one way or another, been in operation for many years.

The major administrative information systems include:

- student admisssions, registration and record-keeping; financial accounting and budgeting; purchasing and physical asset management; personnel administration; fund raising and alumni records; and physical plant systems.

APPROACH TO ADMINISTRATIVE INFORMATION SYSTEMS AT WESTERN

The technical means for development of computerized administrative information systems at Western is modern and typical of the mainstream. Information systems projects are initiated with a request to the Department of Administrative Systems (DAS) which uses the PRIDE methodology for capturing the information necessary to plan a project. Project committees are formed for major projects to manage the phases of development. In most cases, information systems are developed in-house; although Western attempts to evaluate software available from external sources, it has usually been found that already-developed and available software is either unsuitable or deficient, or that in-house development is cheaper or more practical.

Western uses IBM computers, the MVS/XA operating system, and the Cullinet IDMS-R database management software for major information systems. A variety of fairly standard means of connecting administrative workstations to the mainframe administrative computer is used; most administrative offices now employ microcomputers using the MS-DOS operating system. Up-loading and down-loading of administrative data to microcomputers is facilitated with Cullinet's Infogate/Goldengate software. A catalog of administrative databases is maintained and aided by use of the dictionary capabilities of IDMS. This data is regarded as a corporate asset; procedures have been put into place to facilitate and control the use of "corporate" data throughout the university.

ADMINISTRATIVE INFORMATION SYSTEMS STRATEGY

Despite the use of the foregoing resources and methods, Western -- like many universities -- found itself in increasing difficulties in carrying out its information systems development in the mid-1980s. Many of its information systems were in need of re-development. Staff of the Department of Administrative Systems had to be reduced, in view of the "steady state" budget situation, to pay for adequate hardware and software to run the re-developed information systems and to handle the amounts of data and increasing degree of on-line access required for administrative operations. New administrative computer applications were being requested, in addition to a "backlog" of system development work stretching out for three or more years. In fact, many worthwhile projects had simply been put on the "back burner" awaiting sufficient resources.

The Vice-President for Administration foresaw that senior executive action was needed to break the logjam. Even if all worthwhile administrative computing could not be accommodated, there was a need to concentrate resources on the development and maintenance of those information systems which were critical and/or most strategically important. Because of the complexity and scope of the information systems work which could be undertaken, it was difficult to identify the major decisions which were needed, let alone foresee all of the implications for the departments affected. Simplification was needed as a basis for decision-making.

A major consideration was the need to involve senior levels of the administration in decisions regarding information systems development. The reasons were: first, the expense of development of information systems was forcing financial trade-offs which would affect all areas of the administration, and second, the information systems would have a major effect on most areas of administrative operations and therefore needed to be coordinated with general administrative planning.

It was recognized that decisions should not be made, or forced, by the Department of Administrative Systems. It was not considered fair, or appropriate, to expect this department to provide technological leadership, accept responsibility for development of information systems, *and* make decisions as to the priority and timing of new projects. Especially in the emerging technical environment of *distributed computers*, these decisions needed to be a result of collective planning *throughout* the administration.

A classical response in many universities to some of the above difficulties has been the introduction of "hard dollar" chargeback. The basic rationale for this has been to provide a simplified planning concept for the administrative information systems department: they provide whatever clients request and can pay for. It also has the effect of putting the onus on the client departments to obtain resources for information systems. However, this approach has been rejected at Western for the following reasons: first, it would not generate more money in total for administrative computing, and secondly, it would reduce the flexibility of the administration to move information systems resources to the most strategically important or critical projects -- which could very well change quickly according to circumstances.

ADMINISTRATIVE INFORMATION SYSTEMS GOVERNANCE

It was decided to put into place an administrative structure to meet the following objectives:

- Involve the senior levels of administration in decisions relating to administrative information systems. Accordingly, the Priorities and Planning Committee for Administrative Information Systems (PPCAIS) was set up, chaired by the VP, Administration, and consisting of all Assistant VPs as well as the Director of Administrative Systems. This committee became the vehicle whereby major decisions with respect to administrative information systems are taken.
- Involve appropriate staff throughout the administration in matters relating to information systems development. An advisory subcommittee, the Advisory Committee for Administrative Information Systems (ACAIS), was established, consisting of the Directors of most administrative departments, and representatives of all academic faculties -- the "end users" for many kinds of administrative information services. ACAIS is consulted with respect to all major policies and procedures regarding administrative information systems. In addition, a number of special study groups and task forces with technical expertise have been set up to consider certain matters, especially in connection with the initiative for office automation which was launched in the fall, 1988.

A METHODOLOGY

A search was conducted for methods which would facilitate planning and decision-making for major information systems development projects. Vendors and companies, as well as other universities, were consulted. It was concluded that many large organizations, despite investments of millions in "information systems development methodologies", generally "muddle through" where the big decisions were concerned. It was recognized that the tools and methodologies described above could not help in this regard, even though they are useful, if not essential, once a project has been decided upon.

Although "politics" can never be eliminated where major financial decisions were concerned, a method which would reduce the complexity of choosing among dozens of competing projects was desired, as well as a way of conceptualizing the decisions to be made. Many authors advocate the application of information systems resources to the most strategically important projects -- that is, the projects which most directly support the "strategic" goals of the institution. This is undoubtedly a good concept, but Western -- like most large universities -- did not have a clear or explicit plan, strategy, or set of goals which are of direct use in trying to decide which information systems projects should have priority.

It was decided to apply some methods described in the book "The Computer Solution: Strategies for Success in the Information Age", by Eugene F. Bedell, 1985. The methods advocated in this book appear to address the major concerns described above. Although these methods have been successfully applied in a few large corporations, they are not well-known, nor to our knowledge have they been applied in universities. Therefore we are breaking new ground in this endeavour.

The remainder of this paper is devoted to describing in detail the method which we have adopted. The method has some points in common with classical "cost-benefit analysis", but allows a considerable degree of collective executive judgement to be applied. Like any workable decision tool, it is used as a *guide* -- not the last word -- in the decisions we make regarding computerized administrative information systems development at Western.

PRELIMINARY STEPS

The first major task undertaken by PPCAIS was a review of the backlog of information systems development work. This was completed in 1987, and used to set the agenda for information systems development projects in 1988-89[1]. Previously, information systems development work was organized into *projects* and each project has in turn *phases* which are the necessary steps in the execution of a project of this nature: preliminary feasibility studies and definition, systems analysis and design, database design, programming, implementation, and maintenance.

In the summer of 1987, DAS undertook to review and cull the entire backlog of project work in order to provide PPCAIS with current information. About 100 sub-projects (phases) were identified. For each sub-project, a brief description was prepared, and manpower requirements in man-hours were estimated. Fortunately, Western has enough experience with project planning methodology that manpower estimates are now considered quite reliable. This information, however, proved to be too detailed for PPCAIS to identify the major decision points and tradeoffs, so DAS was requested to prepare consolidated "work chunks" -- the goal was to identify 20 to 30 major items of work which could be considered by the general administration. A "work chunk" proved to consist of about 2-3 man-years of development work -- systems analysis and programming. Based on this information, the work plan for 88-89 was approved. At the same time, it was decided to apply the methodology described below in the summer and fall of 1988 to produce the plan for 89-90.

IAU: Importance of an Activity to the University

A basic concept of this methodology is that of an activity. An activity is a major function of the university. In order to understand the importance of alternative information systems to the university, it is necessary to determine: first, which activity an information system supports, and second, *how important that activity is to the university.*

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[1] Western uses an annual planning cycle. In the last quarter and early first quarter of each year, each department submits a plan for the following fiscal year (May through April). Every three years, each department submits a three year plan, which is thoroughly reviewed by the Senate Committee on University Planning. The annual plans provide an update to the three year plan and are accompanied by budget requests. Each year, planning instructions are issued. In the planning for 88-89, departments were asked to comment on their information systems development plans, and in the planning for 89-90, administrative departments and participating academic faculties were asked to include plans for office automation. These plans were collected and provided to PPCAIS for information. Of course, administrative information systems plans of departments are usually developed with the involvement of the Department of Administrative Systems. In this way, DAS has advance notice of client department requirements in order to prepare its own plans and recommendations, which are also reviewed by PPCAIS.

TABLE 1

IAU - IMPORTANCE OF AN ACTIVITY TO THE UNIVERSITY

10:***Critical.*** An activity is *critical* if it must accomplish *outstanding* performance on *all* of its objectives for the university as a whole to achieve its long-term goals.

8: ***Important.*** An activity is *important* if it must accomplish *most* of its objectives for the university as a whole to achieve its long-term goals. The difference between *critical* and *important* is that outstanding performance is not required.

6: ***Contributory***. An activity is *contributory* if it directly contributes to the achievement of the university's long-term goals, but the university may achieve its long-term goals even if the activity fails to accomplish a substantial portion of its objectives.

4:***Support***. An activity is *support* if it does not directly work to accomplish the university's goals, but supports critical, important, or contributory activities, and whose failure will not prevent the university from achieving its long-term goals.

2: ***Overhead***. An activity is *overhead* if it must be done, but does not contribute to achieving the university's long-term goals.

0: ***Detrimental.*** An activity is *detrimental* if it works against achieving the university's long-term goals.

Examples of activities are: recruiting and registration of student; paying staff; financial accounting; budgeting.

It is not necessary to maintain an exhaustive list of all activities at the university. Only those activities for which information systems development is proposed need be identified in a given planning cycle.

In our first consideration of activities, a list of the principal functions of administrative departments was prepared. Generally speaking, single identifiable departments are the focus of a given activity -- that is, a single department usually has the prime responsibility for coordinating and/or carrying out the activity. For each activity so identified, each member of PPCAIS was asked to prepare a *subjective estimate of the importance of the activity to the university,* using a scale of 0 to 10, as shown in Table 1.

The administrative officers applying these ratings must form an idea in their minds of the university's long-term goals, understand the objectives to be accomplished by each activity, and know how accomplishing the objectives will contribute to the achievement of the university's long-term goals. For their judgements to be valid for the university as a whole, it is important that the administrative officers be positioned to make these judgements. PPCAIS seems appropriately constituted for this purpose.

The scores assigned by the members of PPCAIS were clustered and discussed by the group. The officers were asked to revise their estimates. Based upon the revised scores, a composite score representing the central tendency of all the scores was determined for each activity. It is noteworthy that the officers reached a fairly consistent set of scores for the various activities. The discussions of the officers in compiling this scale were interesting and yielded insights into the importance of the various activities at the university. This suggests that the process has team-building value, quite independent of the application of the IAU Scale to information systems decisions.

We should candidly recognize that it is difficult for any employee or officer to voice judgements about the importance of major university-wide activities (particularly outside one's domain of responsibility), and is fraught with political, organizational, and interpersonal overtones. This is especially true when carried through for the first time. It was possible at Western because the members of the PPCAIS are officers who routinely work closely together, and because the scores assigned by individuals have been keep confidential to the group.

It is planned that each year the list of activities IAU Scale will be revised, as necessary, as a first step in the annual planning cycle. It is expected that the IAU Scale will probably not change significantly from year to year, once established. It is probable that the IAU Scale can be applied in other decision-making situations at the University as the officers gain familiarity and comfort with its use.

DEFINITION OF PROJECTS AND SYSTEMS

The second important concept in this methodology is that of a computerized information system (or system for short). Each proposed project over the period for which decisions are made (fiscal years, at Western) leads to the establishment of a computerized information system. In other words, a project produces a system. The task of the decision makers is to choose between projects which compete for resources; or equivalently to set priorities for the acquisition of systems.

Each proposed project is given a descriptive title, a short description in non-technical language, and an estimate of manpower requirements and cost. We have calculated manpower requirements in man-hours, and costs are obtained by multiplying man-hours by $40 -- an estimate of the cost per hour of a programmer-analyst. The decision-makers will choose from the list of projects. An example of a project description is show in Table 2.

At Western departments are permitted to "buy" project manpower from DAS at the rate of $40 per hour. In the past, this has been done routinely for smaller projects and for "ancillary" (cost-recovery) departments. A decision available to PPCAIS is which departments will be required to "buy in" if they wish a project to be undertaken or to raise the priority of their requested work.

TABLE 2

A TYPICAL PROJECT DESCRIPTION

Title: Improve the Reporting of Ledger Account Data

Description: Improve the reporting of general ledger account data, both on line and in hard-copy. Provide for selective account ranges on reports; maintain and display up to five budgets (current and past four revisions); provide management report screens for any period in the current and prior fiscal year; provide tables where ledger account numbers can be linked to an entity code.

Manpower Estimate: 1850 hours

Cost Estimate: $74,000

ISA: The Importance of a Computerized System to an Activity it Supports

It is assumed that each system will support a unique activity. If a system supports more than one activity, this does not invalidate the methodology, but the estimate of how important a system is to an activity needs to be revised (see below). Alternatively, the definition of a system and/or the activity which it supports can be revised so that the system supports a unique activity.

In order to estimate the importance of system to the activity which it supports, the ISA index is prepared, as shown in Table 3. Originally, is was intended that the Department of Administrative Systems would prepare this index in consultation with the client department requesting the project; however, it was found that client department staff tend to overestimate the importance of system development proposals. To date, estimates prepared by PPCAIS are being used. In subsequent decision cycles, a greater effort to involve client department staff in assigning ISA scores is desirable. In order for this exercise to be productive, however, more clarity regarding the definition of activities will be required from senior decision-makers.

TABLE 3

ISA: HOW IMPORTANT IS A SYSTEM TO THE ACTIVITY IT SUPPORTS

10:***Essential Factor.*** A system is an absolutely essential factor in achieving the major objectives of the activity it supports. Note that a system is not essential just because an activity uses it extensively.

5:***Major Support Factor***. A system is a major support factor to an activity if it is not essential to the activity, but can, or already does, play a vital role in supporting the activity.

1:***Minor Support Factor***. A system is a minor support factor for an activity if it helps the activity achieve its objectives but reasonable alternatives are available that are not significantly more costly, less convenient, or less effective, and that would not significantly disrupt operations.

0:***Not Useful***. A system is not useful if the activity it supports does not derive benefits from its use. It should be eliminated.

ISU: The Importance of a System to the University

In order to obtain an estimate the importance of a system to the university, we multiply the two indices, IAU - Importance of the Activity to the University, and ISA - Importance of the System to the Activity. The resulting index, which we may call ISU - Importance of a System to the University - is a value on a scale of 0 to 100.

Both the IAU and ISA Indices are ordinal scales - subjective estimates of the kind familiar to social researchers. We are aware that from a methodological point of view, the multiplication of ordinal indices is questionable. We have adopted this technique for the pragmatic reasons that the procedure is simple, that it separates the construction of the ISU index into two steps involving estimates of two quite different yet important factors, and that it appears to work well enough for our purposes.

ESA: How Effectively does a System Support an Activity

The final index to be compiled is an estimate of how effectively a computerized information system supports an activity, both before and after its development. The ESA Index: How Effectively a System Supports an Activity, is compiled on a scale of 0 to 10 as shown in Table 4. The Administrative Systems in consultation with Client department representatives proposing the system.

TABLE 4

ESA: HOW EFFECTIVELY DOES A SYSTEM Support AN ACTIVITY

10:***Highly Effective.*** A system is functionally appropriate, technically adequate, and cost-effective. Little or no additional work or investment is required for the system, other than routine maintenance.

5:***Moderately Effective***. A system provides a moderate degree of support to the activity, but substantial improvements are needed to improve functional appropriateness, technical quality, or cost-effectiveness.

1:***Ineffective***. A system supports the activity it was designed to support, but ineffectively.

0:***No Support***. No system is currently installed, or the system that is installed is so ineffective as to be worthless.

The Change in Effectiveness Resulting from Installation of a System

In order to estimate the contribution to overall effectiveness resulting from installation of a given system (i.e., from completion of a project) we weight the change in the ESA Index with the ISU Index - Importance of the System to the University. The two values are multiplied together, that is:

The Change in Total Effectiveness Resulting From Installation of a System

= (ESA(New) - ESA(Old)) X ISU = (ESA(New) - ESA(Old)) X IAU X ISA

The resulting effectiveness index is on a scale from 0 to 1000. It can be divided by the largest value and multiplied by an arbitrary number (normalized) to facilitate comparison. We rank-order the resulting numbers to facilitate consideration by the decision-makers. An example of the calculations are shown in Table 5, using data for 1989-90.

Estimates of Cost-Effectiveness

A final step can be taken to introduce a measure of cost-effectiveness for each project. This is obtained by taking the index of increase in effectiveness and dividing by the estimated cost for the project to produce the system. Given the direct relationship between cost and man-hours at Western, we can equivalently divide by man-hours. For convenience, the resulting numbers can be normalized to obtain a Cost-Effectiveness Index. We rank-order the resulting numbers in order to facilitate consideration by decision-makers. See Table 5.

Use of the Indices by Decision Makers

The resulting indices are used as a guide to decision-making. The decision makers must consider how many projects can be undertaken in a given planning period, any logical inter dependencies among the projects, timing, and any other factors relating to planning outside the scope of this methodology. Using manpower estimates as a surrogate for costs, and assuming that the pool of manpower is known in a given planning period, the projects must be fitted into the agenda for the manpower available.

Once priorities have been assigned, the projects can be listed in priority order, and cumulative manpower calculated. In this way, the amount of work which can be accomplished in the following planning period can be readily identified. See Table 6 for an example, where the projects have been ranked in the order of estimated cost-effectiveness.

We consider that a programmer-analyst can produce approximately 1000 hours of project work in a year, taking into account training time, vacation, average sick time, and other activities which cannot be assigned to projects.

Each project can be viewed as a "rectangle" which can be stretched out or shortened according to the number of analysts assigned to the work. The height of the rectangle is proportional to the number of analysts assigned, and the area is proportional to the size of the project measured in man-hours. This, of course, is a standard way of planning manpower assignments. See Table 6 for a feasible schedule resulting from an selection of projects from the list in Table 5.

TABLE 5
PROPOSED VS DEVLOPMENT PROJECTS

PROJECT	(A) I.A.U.	(B) I.S.A.	(C) OLD E.S.A.	(D) NEW E.S.A.	(E) (ADD ABC) CHANG EFFECT.	(F) EFFECT RANK	(G) MAN MTHS per project	(G) MAN MTHS cumm	(H) EFFECT/ MAN MTHS
FINANCE									
1. GENERAL LEDGER ON-LINE ENTRY	4	10	1	10	360	3	24	24	7
2. RESEARCH ACCT ON LINE ENTRY	6	5	1	10	270	8	71	95	17
3. LEDGER ACCT REPORTING	4	5	5	10	100	17	22	117	16
4. MISC PROJECTS-FINANCE	4	5	5	5	0	26	39	156	26
D.A.A.R.									
5. OFFERS OF ADMISSION	8	10	5	10	400	2	8	8	1
6. MISC PROJECTS - ADMISSIONS	8	5	5	5	0	25	24	32	22
7. MISC PROJECTS - STU RECORDS	4	5	5	5	0	24	37	69	24
PERSONNEL									
8. MANPOWER ON-LINE ENTRY	4	5	1	10	100	11	35	35	14
9. PENSION ADMIN/TAX REFORM	4	5	1	5	80	20	26	61	19
10. PAY EQUITY/SAL INCR	6	10	1	10	540	1	25	86	3
11. APPOINTMENT LINES	4	10	1	10	280	7	42	128	10
12. NEW DATA ELEMENTS	4	10	1	10	360	5	44	172	11
13. EMPLOY EQUITY	6	5	0	5	150	12	5	177	2
14. MISC PROJECTS-PERSONNEL	4	5	1	5	80	19	48	225	21
OTHER SYSTEMS									
15. CAD INTERFACE	4	5	0	5	100	15	5	5	4
16. SCHOLARSHIP DOWNLOADING	4	1	1	5	16	21	5	10	18
17. PURCHASING ONLINE ENTRY	4	10	1	10	360	6	54	64	13
18. IDMS/ONLINE - COST LEDGER	4	5	5	10	100	14	21	85	15
19. IDMS/ONLINE - B&G SYSTEM	4	5	1	10	100	10	24	109	12
20. BANK DEPOSIT - FND'N WESTERN	8	5	5	10	200	9	11	120	6
21. IDMS/ONLINE - FEES	4	5	5	10	100	18	43	163	20
22. MISC PROJECTS - ALUMNI	6	5	1	5	120	13	14	177	9
23. MISC PROJECTS - DEV OFFICE	8	5	5	5	0	22	4	181	23
24. POINT OF SALE - BOOKSTORE	4	5	0	5	100	16	5	186	5
25. IDMS/ONLINE - GRAD STUDIES	8	5	1	10	300	4	32	218	8
26. MISC PROJECTS - LIBRARY	6	1	5	5	0	23	8	226	25

TABLE 5
PROPOSED VS DEVELOPMENT PROJECTS
BASED ON COST EFFECTIVENESS

	PROJECT	MAN MONTHS PROJECT	MAN MONTHS CUMMULATIVE	
05.	OFFERS OF ADMISSION	8	8	
13.	EMPLOYMENT EQUITY	5	13	
10.	PAY EQUITY/SALARY INCREASES	25	38	
15.	CAD INTERFACE - SPACE SYSTEM	5	43	
24.	POINT OF SALE SYSTEM - BOOKSTORE	5	48	(1989-90)
20.	BANK DEPOSIT - FOUNDATION WESTERN	11	59	
01.	GENERAL LEDGER ON-LINE ENTRY	24	83	
25.	IDMS/ONLINE - GRADUATE STUDIES	32	115	
22.	MISCELLANEOUS PROJECTS - ALUMNI	14	129	
11.	APPOINTMENT LINES	42	171	
12.	NEW DATA ELEMENTS - PERSONNEL	44	215	
19.	IDMS/ON-LINE PHYSICAL PLANT SYSTEMS	24	239	(1990-91)
17.	PURCHASING ON-LINE ENTRY	54	293	
08.	PERSONNEL - ON-LINE ENTRY	35	328	
18.	IDMS/ON-LINE - COST LEDGER	21	349	
03.	GENERAL LEDGER ACCOUNT REPORTING	22	371	
02.	RESEARCH ACCOUNTING ON-LINE ENTRY	71	442	
16.	SCHOLARSHIP DOWNLOADING	5	447	
09.	PENSION ADMINISTRATION/TAX REFORM	26	473	
21.	IDMS/ON-LINE FEES SYSTEM	43	516	
14.	MISCELLANEOUS PROJECTS - PERSONNEL	48	564	
06.	-ADMISSIONS	24	588	
23.	-DEV. OFFICE	4	592	
07.	-STUD. RECORDS	37	629	
26.	-LIBRARIES	8	637	
04.	-FINANCE	39	676	